

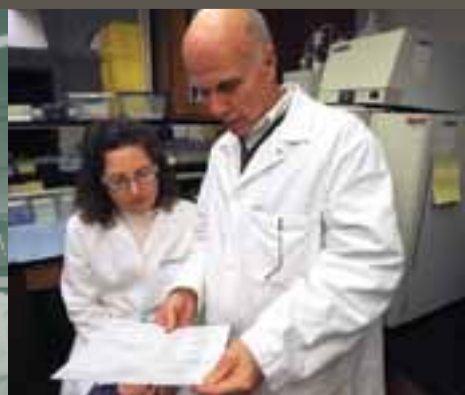


15<sup>TH</sup> ANNIVERSARY EDITION

# SEEDS


SEEDS: The OARDC Research Enhancement  
Competitive Grants Program

REPORT OF  
PROGRESS  
FOR CALENDAR  
YEAR 2011



Bringing Knowledge To Life  
[www.oardc.osu.edu/seeds](http://www.oardc.osu.edu/seeds)





---

At any given time, OARDC scientists are engaged in more than 400 research projects in the areas of agricultural, environmental, and development economics; food, agricultural, and biological engineering; animal sciences; entomology; food animal health; food science and technology; horticulture and crop science; human and community resource development; human ecology; natural resources; and plant pathology.

---



Dear Colleagues,

As a valued partner in all that we do at the College of Food, Agricultural, and Environmental Sciences at The Ohio State University, I hope you enjoy reading this special issue of the SEEDS Report of Progress. This report provides results of projects completed in the 15<sup>th</sup> year of the program, which coincides with the 150<sup>th</sup> anniversary of Justin Morrill's Land Grant Act that established universities like The Ohio State University. It seems most fitting that we commemorate these important points in time and the exceptional research conducted by our researchers, staff, and students.

The Ohio State University's Ohio Agricultural Research and Development Center (OARDC) established SEEDS: The Research Enhancement Competitive Grants Program in 1996 with a primary focus of conducting "research to benefit Ohioans." This focus continues today and into the future. At times, this can be a significant challenge because land grant universities must conduct relevant, timely, and state-of-the-art research by seeking funding through competitive grant programs that attract hundreds, if not thousands, of applicants resulting in success rates of 10-20%. Faculty in the College of Food, Agricultural, and Environmental Sciences must gain a competitive advantage to be successful with extramural grant programs (e.g. USDA, NSF, NIH) and to form partnerships with private industry. Thus, the SEEDS program was developed with two primary focuses. First, SEEDS exists to assist faculty in obtaining initial information that strengthens grant proposals and increases the chances for funding outside the university. Second, it facilitates public-private partnerships that result in solutions to industry needs and a clear path to market for university-based discoveries. Overall, the goal of the SEEDS program is to enhance our faculty's capacity to do research that benefits Ohioans.

Funding for the SEEDS program began in 1996 with \$250,000 and in 2012 SEEDS supports \$1.5 million in research activity for a total of \$19.5 million for the life of the program. Most projects are completed in two to three years and investigators are required to report scientific results in addition to any funds obtained as a result of SEEDS. For any given year the return on investment based on "end-of-project" reporting varies considerably but averages almost \$5.00 for every dollar invested.

We hope you enjoy this special edition and would like to thank our researchers, staff, non-profit collaborators, industry partners, and various contributing entities who have continued to support and ensure the success of the SEEDS program.

Thank you,

A handwritten signature in black ink, which appears to read "F. William Ravlin". The signature is fluid and cursive.

F. William Ravlin  
Associate Director  
Ohio Agricultural Research and Development Center  
The Ohio State University



# SEEDS: Celebrating 15 Years

1996

1996 RECGP (Research Enhancement Competitive Grants Program) began



1996 Matching competition introduced

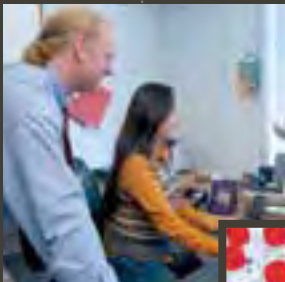


1998 Seed, Interdisciplinary, Industry Small competitions introduced



1999 Undergraduate competition introduced

1999 First Report of Progress published



2000



2000 Master's and Doctoral Competition introduced



2000 New Enterprise competition introduced



2001–2002 Payne competition



2000–2004 International competition



2002 Grant-writing awards



2002 Program name change to SEEDS: The OARDC Research Enhancement Competitive Grants Program

2011

Total amount distributed in awards ..... \$19,516,756

# Contents

**06** Current and Past Collaborators

**08** Introduction

**12** Achievements by Objectives

**14** Interdisciplinary Team Competition

**26** Matching and Industry Small Grant Competitions

**40** New Enterprise Competition

**44** Seed Grant Competition

**64** Student Projects

**72** Publications, Presentations, and Graduate Students

**80** Past Funded Projects



# Current and Past Collaborators

3-I	Bedding Plants Foundation, Inc.	Consortium for Plant Biotechnology Research	General Chemical
6062 Holdings LLC	Berlin Natural Baker, Inc.	Cooper Farms, Inc.	George F. Ackerman Company
AccuDX Inc.	Biotechnology Research and Development Corporation	Cultiva	Great Lakes Hosta Society
Ag-Spectrum	Boehringer Ingelheim-NOBL	Dairy Management, Inc.	Gregson Technologies, Inc.
Alltech	British Columbia Greenhouse Growers' Association	Danone	Gustafson, Inc.
Alpaca Jack's Suri Farm	British United Turkeys of America	DeVenture	Harris Moran Seed Company
American Aggregates Corp.	California Avocado Commission	Donlar Corporation	Hillshire Farm and Kahn's
American Berry Cooperative	Camelid Health Foundation	Dow Agrosiences	Hirzel Canning Co.
American Coal Ashland Association	Campbell R and D	Dynal Biotech	Holmes Cheese Company
American Hosta Society	Cargill Animal Nutrition Center	E.I. DuPont de Nemours and Co.	Holmes Cheese Table
Ampac Seed Company	Cattlemen's Carcass Data Service	Eagle-Picher Minerals, Inc.	Horticultural Research Institute
Antorchas Foundation	Center for Aseptic Processing and Packaging Studies	Earthgro	Iams Corporation
Archer-Daniels-Midland Company	Central Ohio Hosta Society	Edstrom Industries, Inc.	Infectech, Inc.
Argus Control Systems Ltd.	Certified Angus Beef	Elanco Animal Health	Ingredient Innovations International
Around the World Gourmet	Ciba Crop Protection	Eli Lilly and Company	Integrated Research Technology, LLV
Asgrow Seed Company	Cinergy	Farmland Industries	J. Frank Schmidt Family Charitable Foundation
Athersys Inc.	City of Columbus	First Energy	Jarrow Incorporated
Aviagen	Cognis Deutschland GmbH and Co.	Floriculture Industry Research and Scholarship Trust	Jatco, Inc.
BASF Plant Science GmbH Agrarzentrum Limburgerhof		Food Science Australia	Kamiasahi Feed Lot, Ltd.
Bass Endowment		Fremont Pickle Growers Association	Kanter Associates
Bayer Corporation		Fruit Growers Marketing Association	Kohlpyr
Bayer CropScience LP Environmental Sciences		Garick	Kraft Foods Global, Inc.



Kurtz Brothers, Inc.	Novartis Crop Protection, Inc.	Ontario Greenhouse Vegetable Growers	Satloc
Lilly Research Laboratories	Nursery Growers of Lake County Ohio, Inc.	Optimum Quality Grains, LLC	Schmack Bio Energy
Lipha Tech, Inc.	N-Viron International, Inc.	Otterbein University	Select Sires
Lipton Tomato Research Center	Ohio Bioprocessing Research Consortium	Outback	Seminis Vegetable Seeds, Inc.
Loveland Industries, Inc.	Ohio BioProducts Innovation Center	Park Foundation	Small Farm Institute
Magical Farms, Inc.	Ohio Corn Marketing Program	Pennington Seed, Inc. Oregon Division	Smathers-Oasis Company
Maple Leaf Farms, Inc.	Ohio Dairy Farmers Federation, Inc.	Petroseed	Syngenta
Martel Biosciences Corporation	Ohio Dairy Producers	Pfizer	The Chef's Garden, Inc.
Merial Limited	Ohio Floriculture Foundation	Pharmacia, Wyeth Ayerst Research	The Garland Company, Inc.
MicroBio Limited	Ohio Fruit Growers Society	Philip Morris, Inc., Shared Solutions in Agriculture	The HANOR Company, Inc.
Mid-America Food Processors	Ohio Lawn Care Association	Phycotransgenics	The Scotts Company and Subsidiaries
Middlefield Cheese	Ohio Nursery and Landscape Association, Inc.	PIC USA	Theis Technology Inc.
Midtech	Ohio Pork Producers Council	Pig Improvement Company	Thomas Cook
Midwest Regional Hosta Society	Ohio Poultry Association	Pioneer Hi-Bred International, Inc.	Toh Products, LLC
Ministry of Culture, Education, and Scientific Exchanges, Spain	Ohio Seed Improvement Research	Polter Berry Farm	Top Soil Precision Ag
MTD Products	Ohio Sheep and Wool Program	Protein Technologies International	Tree Research and Education Endowment Fund
National Fish and Wildlife Foundation	Ohio Soybean Council	Purity Foods, Inc.	TruGreen-Chemlawn
National Sea Grant Program	Ohio Space Grant Consortium	Quality Liquid Feeds	Turkish Republic Harran University
National Wildlife Federation	Ohio Vegetable and Small Fruit Research and Development	Rainbow Treecare Scientific Advancements	Valent USA Corp.
Natural Fiber Composites Corporation		Rainforest Phytochemicals	Warner Endowment Grant
North American Strawberry Growers Research Foundation, Inc.		Raven	Welch's
Nourse Farms, Inc.		Rhodia, Inc.	West Texas A and M
		Roche Vitamins Inc.	Wilmington College



---

Established in 1996 and supported by an appropriation from the Ohio General Assembly to OARDC, SEEDS: The

OARDC Research Enhancement Competitive Grants Program is unique among U.S. state-assisted universities. In fostering high-quality research among scientists supported by OARDC and The Ohio State University's College of Food, Agricultural, and Environmental Sciences (CFAES), SEEDS enables those scientists to collect the preliminary data needed to give them a competitive edge in national programs, and it provides them with leverage to attract industry support.

---



# SEEDS: The OARDC Research Enhancement Competitive Grants Program

The oldest industry known to humankind is still the one driving Ohio's economy. The economic powerhouse that is Ohio's agbioscience industry is unparalleled. Agriculture is the most distributed industry across Ohio with operations in every county. It accounts for \$98 billion, or 11%, of the state's total economic output and generates more than 984,000 Ohio jobs (15% of all employment in the state). No other economic engine comes close to making the kind of impact generated by agriculture, food, and the nursery and landscape industry. This massive industry employs one in every six Ohioans and supports a diversified and dynamic economic sector that touches the lives of everyone in the state. At any given time, there are over 230 scientists conducting more than 400 research and development projects annually at the Ohio Agricultural Research and Development Center (OARDC).



and opportunities in key areas such as environmental restoration, organic agriculture, and the development of biorenewable sources such as energy, fuel, and industrial goods. Opportunities abound in biobased industrial products, and agbiosciences holds the promise of stimulating new economic growth across existing and new economic sectors throughout the state.

The ultimate goal of SEEDS: The OARDC Research Enhancement Competitive Grants

Program is to address the differing challenges and vast opportunities of Ohio's largest industry. SEEDS encourages excellence in OARDC research by promoting exploration that is consistent with the mission and vision of the Ohio Agricultural Research and Development Center and by encouraging connections across disciplines, with industry, and with other external partners.

The innovations produced in the agbiosciences are driving new, highly visible economic opportunities for American states, and the State of Ohio has been an early mover in recognizing the economic development potential of the industry. As the nation's largest and most comprehensive agbioscience research center, OARDC at The Ohio State University is a pioneer of cutting-edge innovation, establishing itself among the essential drivers of Ohio's economy. OARDC is the research and development hub for agbioscience research in Ohio and serves as the state's signature research center for realizing progress in all significant aspects of the biobased economy. OARDC's Ohio impacts generated 1,609 jobs; \$156.3 million in economic output; \$59.2 million in personal income for Ohio residents; and \$5.5 million in state and local taxes. In a knowledge-driven economy, intellectual property is perhaps the most valuable property that can be produced.

Due to the changing nature of economic and societal trends, agriculture, food, and the green industry depend on innovators and researchers to generate new processes and products. Ohio's largest industry increasingly links with other industries to take on common challenges

Established in 1996 and supported by an appropriation from the Ohio General Assembly to OARDC, SEEDS: The OARDC Research Enhancement Competitive Grants Program is unique among U.S. state-assisted universities. In fostering high-quality research among scientists supported by OARDC and The Ohio State University's College of Food, Agricultural, and Environmental Sciences (CFAES), SEEDS enables those scientists to collect the preliminary data needed to give them a competitive edge in national programs, and it provides them with leverage to attract industry support.

OARDC's SEEDS program is just one of the many ways in which The Ohio State University's innovative research and development connects to industry and community on an eminent global scale. Currently, Ohio State is ranked 19th among the nation's public universities and has been among the top 25 public research universities in each *U.S. News & World Report* ranking. According to the National Science Foundation's assessment of sponsored research expenditures, Ohio State ranks among the top 10 public research universities in the country.

## Objectives

SEEDS was created to encourage partnerships with industry and other stakeholders and to increase the competitiveness of OARDC/CFAES scientists in extramural grant programs. While these objectives remain as the program's cornerstone, SEEDS has grown to include a total of seven objectives:

- 1. Increase the competitiveness of scientists in extramural grant programs.**
- 2. Encourage partnerships with industry and other stakeholders.**
- 3. Encourage the development of interdisciplinary teams.**
- 4. Encourage international collaborations.**
- 5. Support the exploration of enterprises that are potentially new to Ohio.**
- 6. Provide undergraduate students with research experience.**
- 7. Provide graduate students with the opportunity to take part in the grant-writing/review process.**

By providing SEEDS money to develop the necessary preliminary data for a strong grant application or by matching funds to leverage external funding, SEEDS has proved to be a valuable program for scientists in the College of Food, Agricultural, and Environmental Sciences. Within the context of our global society, the SEEDS program looks forward to continued success and new partnerships with industry and other collaborators in Ohio and throughout the world.





## Program Achievements

Overall, SEEDS or SEEDS-funded researchers and/or graduate students have ...

- supported research projects of more than \$19 million in all categories and have received over \$73 million in matching and extramural funding — **a return of about \$5.00 for each dollar invested.**
- invested \$3.4 million in projects requiring matching funds, generating \$6.8 million in industry matches — **a return of over \$12.00 for every dollar invested over the last five years.**
- enabled scientists to establish collaborations with colleagues from Africa, Argentina, Australia, Belgium, Brazil, Chile, France, Ireland, Italy, Mexico, New Zealand, Norway, the Philippines, Switzerland, Taiwan, Uganda, and Zimbabwe.
- applied for nine U.S. patents, using results of initial findings. Three patent applications have been granted, and three licensing agreements have been obtained.
- published a total of 807 peer-reviewed scientific manuscripts, abstracts, popular press articles, bulletins, and/or book chapters and made more than 1,365 presentations throughout the world.
- produced 53 doctoral dissertations and 82 master's theses.



# Achievements by Objectives

## Objective 1: Increase the competitiveness of scientists in extramural grant programs.

The **Seed Grant Competition and the Agency External Competitions** specifically address Objective 1. However, all the other competitions may result in additional funding from outside sources.

Of the 52 projects completed and reported in calendar year 2011, \$11,690,633 was generated in extramural funding. Over the life of SEEDS, 425 projects have been completed and \$73,109,322 has been generated extramurally.

Over the life of SEEDS, OARDC has invested \$774,785 in matching funds for Agency External Grants, which has generated \$10,237,942 in extramural funding – a return of more than \$13.00 for each dollar invested in the SEEDS category.

## Objective 2: Encourage partnerships with industry and other stakeholders.

The **Matching and Industry Small Grant Competitions** address Objective 2.

Of the 18 grants requiring at least a dollar-for-dollar match and completed during calendar year 2011, OARDC provided a total of \$297,180 while industry matched those dollars.

Over the life of the program, OARDC has provided \$3,626,031 toward Matching and Industry Small Grants while industry has matched these dollars with \$6,806,221 – a return of 53%.

## Objective 3: Encourage the development of interdisciplinary teams.

The **Interdisciplinary Team Competition** specifically addresses Objective 3.

During calendar year 2011, eight interdisciplinary teams completed projects. These teams reported receiving \$2,568,230 in extramural funding.

Over the life of the program, six colleges and 23 departments have participated in this category of competition, with OARDC investing \$7,307,329 and teams competing successfully and reporting \$18,985,850 in extramural funding – a return of about \$3.25 on each dollar invested.

## Objective 4: Encourage international collaborations.

All competitions may have an international collaboration component, and international relationships are encouraged. OARDC scientists have collaborated with scientists from Africa, Argentina, Australia, Belgium, Brazil, China, Chile, France, Ireland, Italy, Mexico, New Zealand, Norway, the Philippines, Switzerland, Taiwan, Uganda, and Zimbabwe.

## Objective 5: Support the exploration of enterprises that are potentially new to Ohio.

New enterprises are considered to be crops, animals, products, goods, and services that currently are not produced for biological, physical, cultural, processing, economic, or social reasons. **The New Enterprise Competition** is designed to explore new enterprises and to eliminate the barriers that constrain existing ones.

The New Enterprise Competition has received 39 applications; 15 have been funded.



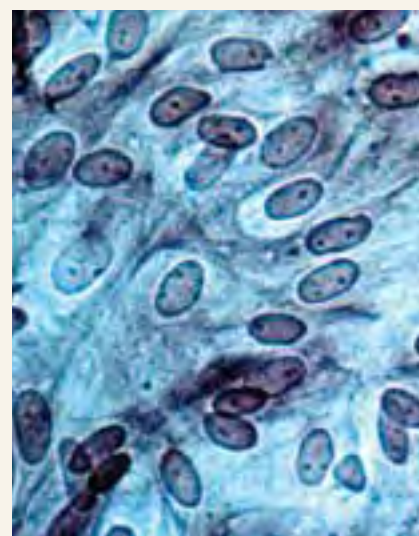


**Objective 6: Provide undergraduate students with research experience.**

A total of 79 applications to the **Director's Undergraduate Research Program** have been received; 52 applicants have received awards.

The Director's Undergraduate Research Program provides undergraduate students with a professional grant-writing, research, and reporting experience. Projects are designed, submitted for review, and carried out with a faculty mentor. Once a project is completed, students take an independent studies class to write their research report in the form of a scientific journal article, using their faculty advisor as an editor. Some of these reports get published. In addition, many students present their research at professional meetings and at competitions such as the Denman Undergraduate Research Forum, a university-wide program presented by The Ohio State University Office of Research and The University Honors and Scholars Center.

SEEDS was created to encourage partnerships with industry and other stakeholders and to increase the competitiveness of OARDC/CFAES scientists in extramural grant programs.




**Objective 7: Provide graduate students with the opportunity to take part in the grant-writing/review process.**

A total of 309 master's and doctoral students have submitted proposals to the **Director's Graduate Research Competition**; 200 projects have been awarded. The graduate competition is run exactly like a federal competition. Graduate students who receive awards are asked to serve on a panel to review applications in the following year's competition. This experience provides students with the opportunity to develop their skills in grant-writing and reviewing — skills that are essential to their careers.

# Interdisciplinary Team Competition





A young man in a white lab coat is seated at a table, holding a test tube to his mouth. In the foreground, a white petri dish contains several small, dark, irregularly shaped samples. The background is a plain wall with a few items hanging on it, including a framed picture and a small electronic device. The entire image has a dark teal overlay.

**The Interdisciplinary Team Competition, funded at a maximum \$100,000 level, is designed to stimulate new collaborative partnerships in multiple departments and colleges or build on existing programs of excellence. Interdisciplinary research provides expertise over several disciplines, bringing a more holistic approach to research questions and problems.**



---

The OARDC SEEDS: Research Enhancement Competitive Grants Program was developed to seed new ideas and

form new partnerships with private industry; it enhances our alignment with societal needs. More than \$19 million in SEEDS grants have been allocated and this has enabled the college to leverage an additional \$5.00 for every dollar we have invested. These investments are being made in our strategic signature areas and serve to strengthen faculty programs, student capabilities, and better align the college with Ohio State's Discovery Themes of: Health and Wellness, Energy and Environment, Food Production and Security. — *Bobby Moser, Vice President for Agricultural Administration and Dean, CFAES*

---

# Using improved land-use data to strengthen rural and urban economies

Mark Partridge, Agricultural, Environmental, and Development Economics

Casey W. Hoy, Entomology

David S. Kraybill, Agricultural, Environmental, and Development Economics

Linda M. Lobao, Human and Community Resource Development

Douglas Southgate, Agricultural, Environmental, and Development Economics

The struggling U.S. economy has highlighted the importance of generating economic opportunities and enhancing Ohioans' quality of life. Economic development was a key issue in the 2010 statewide elections, and the 2011 legislative session emphasized job-creating policies, including reconfiguring how the State of Ohio conducts economic development policy. The ability of Ohio's towns and cities to recover will depend on the extent to which they implement "best practices" in economic development.

The research team saw the need for high-quality empirical research to evaluate which best practices can rejuvenate Ohio's towns and cities. The key for Ohio communities will be to entice financial resources and entrepreneurs by ensuring them higher returns than elsewhere. Furthermore, providing higher quality of life will attract and retain skilled workers. Properly managing and preserving the state's environmental and agricultural resources is also an integral part of implementing best practices at the state and local levels.

This collaborative project brought together a team of scientists from economics, environmental science, and sociology to address how Ohio communities can maintain their competitive edge. The project strove to provide the first detailed assessment of regional interactions across county governments in the United States. In addition, it was the first to document land-use practices nationwide, including all counties, ranging from remote and rural to highly urbanized. The team also systematically researched policies that can facilitate intergovernmental cooperation across a wide swath of activities in economic development, public services, and land use.

The key for Ohio communities will be to entice financial resources and entrepreneurs by ensuring them higher returns than elsewhere.

This project made significant strides in its efforts. It developed a sophisticated database of land-use measures using Geographical Information Systems (GIS), a system designed to capture, store, manipulate, analyze, manage, and present all types of geographical data. GIS was used along with other spatial analytical methodologies to construct maps of these land-use measures.

The project successfully collected a wide and deep range of data on employment, income, industry, county-level taxes and expenditures, and demographics. Using this data, the team created a national, cross-time database that merges nationwide county-level government survey data and formed a GIS layer of land-use pattern statistics that characterize farm and landscape diversity and layer soil spatial patterns.

The project provided a better understanding of how local governments compete with each other and how better cooperation can improve economic development outcomes. Moving forward, the research team will use this collection of data to understand which communities continued to grow during the recession and why, and what types of local government policies can help to ensure their continued success.

Mark Partridge





## Improving food safety by reducing *E. coli* infections in cattle

Jeffrey T. LeJeune, Food Animal Health Research Program

Stephen T. Abedon, Microbiology

Brian B. McSpadden Gardener, Plant Pathology

Consumption of food or water contaminated with *Escherichia coli* O157 bacterium can cause severe illness or even death in humans. About 63,000 cases of *E. coli* are reported every year in the United States, taxing the public health system by some \$634 million dollars. This disease thus costs Ohio about \$23 million per year. Foods of bovine origin and the environment in which the cattle are housed can be contaminated when healthy cattle harbor the bacteria and shed it in their feces. Thus, controlling and preventing *E. coli* infections in cattle can improve the safety of the food supply and reduce environmental contamination.

How cattle become infected with the bacteria and what factors allow for the organism to persist or multiply in cattle or on farms is not completely understood. Based on an understanding of other infections in cattle and previous research, the research team proposed that cattle get infected from their environment. Certain materials used for livestock bedding promote *E. coli* survival, while other materials suppress or limit its survival. Identifying the specific factors that control the survival of *E. coli* in different environments can help determine which bedding materials are best to limit the amount of *E. coli* to which the cattle are exposed, thereby reducing their infection rate and the likelihood of food supply and environmental contamination.

The research team inoculated *E. coli* into cattle bedding material collected from dairy farms. When some of the samples were heated prior to inoculation, the bedding materials no longer suppressed the bacterium. Thus, the team hypothesized that the factors that suppress *E. coli*

in bedding are microbial. Using molecular fingerprinting methods, the researchers determined which bacterial populations best suppressed the *E. coli*.

Future research will isolate the specific bacteria that inhibit *E. coli* growth in the bedding samples. Once these organisms are isolated, it may be possible to add them to livestock feeds or to the farm environment to help lower *E. coli* levels. If successful, these steps can help to improve food and environmental safety.

Jeffrey T. LeJeune



Controlling and preventing *E. coli* infections in cattle can improve the safety of the food supply and reduce environmental contamination.

## Promoting oral health with fruit compounds

Yael Vodovotz, Food Science and Technology

Steven J. Schwartz, Food Science and Technology

Christopher Weghorst, School of Public Health

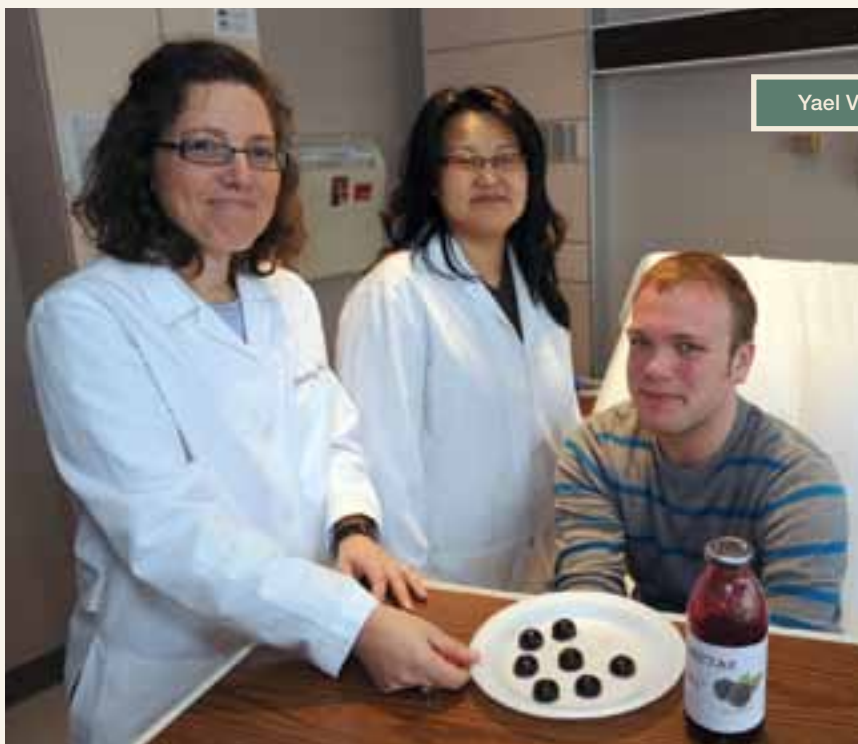
Oral diseases such as gum disease, tooth loss, and oral cancer are widespread among Americans. Over 35,000 new cases of oral cancer are diagnosed each year, and nearly 99 percent of all Americans between the ages of 40 and 44 have experienced an oral disease. Additionally, Americans spent an estimated \$109 billion on dental clinic visits in 2009. Oral infections have also been linked with diabetes, heart disease, and stroke.

Recent studies have found that naturally occurring chemical compounds in strawberries, collectively called phytochemicals, may provide benefits that could promote oral health. Thus, oral delivery of fruit compounds using a strawberry confection may be a convenient, complementary, and alternative therapy for preventing oral disease. To test this hypothesis, the research team evaluated compliance and safety of strawberry confections used for oral health treatment by conducting a randomized trial in 34 men and women (17 smokers and 17 non-smokers). Participants consumed eight pieces per day of freeze-dried strawberry confections for one week and then strawberry-flavored confections for another week — the equivalent of one cup of whole strawberries per day.

The team evaluated the absorption and excretion of strawberry compounds in saliva, oral tissues, and urine. In addition, they investigated biological markers of oral health (genetic expression and salivary inflammatory markers).

At the time of publication, the study was ongoing. The results will be used to assess the strawberry compounds' ability to promote oral health and provide the basis for further berry research focused on disease prevention. Specifically, these critical preliminary findings lay the foundation for future large-scale clinical trials using freeze-dried black raspberry confections in a population with oral cancer and/or oral disease. Black raspberries have a larger quantity of similar phytochemicals, and The Ohio State University has been working with black raspberries for many years in oral and esophageal cancers.

More generally, the data gathered from these clinical trials could provide researchers and the general public with valuable information about options for disease prevention that can be used in everyday meal planning and potentially new, innovative, and functional food products aimed at improving oral health.



Yael Vodovotz

Recent studies have found that naturally occurring chemical compounds in strawberries, collectively called phytochemicals, may provide benefits that could promote oral health.

## Identifying soybeans resistant to pests and pathogens

Anne E. Dorrance, Plant Pathology  
Asela Wijeratne, Molecular Cellular Imaging Center  
Rouf Mian, Horticulture and Crop Science  
Leah McHale, Horticulture and Crop Science  
Steve St. Martin, Horticulture and Crop Science

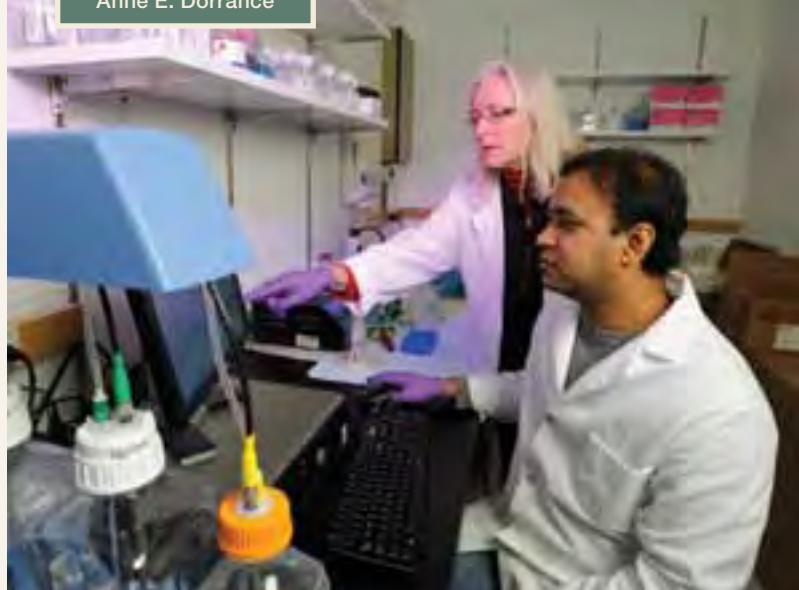
Farmers prefer to grow soybean varieties with specialty traits — e.g. high protein for increased feed value or low fatty acid for higher-quality soybean oil — to increase their market value. However, Ohio producers face a number of production challenges related to plant pathogens or pests. A key management strategy is to plant cultivars with resistance to these challenges.

The OARDC research team has identified soybean germplasm with resistance to many of the main pathogens that attack soybeans produced in Ohio. OARDC's partnership with the U.S. Department of Agriculture's Agricultural Research Service (USDA-ARS) soybean breeding program has identified insect-resistant soybean lines. The next challenge is to identify the genetic regions that contribute to the expression of these traits and incorporate these regions into high-yielding, adapted germplasm cost-effectively and efficiently. Marker-assisted-selection is a technique in which the molecular markers associated with a trait are monitored through the breeding process to quickly identify those lines that have the genetic regions and, therefore, the trait of interest.

Ohio producers face a number of production challenges related to plant pathogens or pests. A key management strategy is to plant cultivars with resistance to these challenges.

Shortly after this project began, the USDA-ARS laboratory in Beltsville, Maryland, announced it would screen a panel of 1,536 molecular markers on key soybean lines. The

Anne E. Dorrance



OARDC team provided 96 lines that were top breeding parents, new sources of resistance, or had specialty traits. This immediately gave the team access to a database of molecular markers for these lines from which molecular mapping efforts could be expedited. With this as its foundation, the team could begin to identify genetic regions associated with resistance to soybean pests and pathogens in Ohio.

OARDC's Molecular and Cellular Imaging Center, together with the Ohio Biotechnology Innovation Center, had recently purchased the BeadXpress system, which enabled the research team to quickly perform millions of genetic tests. This system allows analysis of one to 384 different molecular markers in any given number of individuals. It is far less expensive than conventional methods and can be used to genotype as many as 96 individuals simultaneously.

Using the BeadXpress system and the database of molecular markers, the team has analyzed a large number of molecular markers on fifteen different soybean populations, providing a total of 580,538 informative data points. Analysis is underway to identify additional molecular markers and genetic regions associated with resistance to a variety of pests and pathogens, and several have already been discovered. As a result of these new technologies, the molecular markers associated with these resistances can be integrated more quickly into high-yielding, Ohio-adapted soybean cultivars, eventually benefiting both Ohio farmers and the state's economy as a whole.



# Developing sustainable bioenergy systems for Ohio farms

Yebo Li, Food, Agricultural, and Biological Engineering

Carri Gerber, Agricultural Technical Institute

Richard H. Moore, School of Environment and Natural Resources

Chinese farmers use an integrated greenhouse agro-ecosystem known as “4-in-1,” which uses on-farm feedstocks and animal waste to produce biogas as a sustainable energy source. OARDC researchers have worked to evaluate the viability of feedstock found in Ohio for use in bioenergy, with the goal of reducing greenhouse gas emissions. Specifically, this project aimed to emulate the 4-in-1 model on an Ohio Amish dairy farm in the Sugar Creek Watershed. In the Amish sustainable energy system, the team integrated dairy cows, biogas, decorative plants and vegetables, and a solar water heater in a greenhouse. The system’s key component is anaerobic digestion, in which bio-degradable material is broken down (without oxygen) to release energy.

To increase biogas production on an individual farm, the digestion facility should be capable of converting a wide variety of the farm’s organic wastes. The team analyzed methane yield and productivity by volume during anaerobic digestion of eight feedstocks — switchgrass, corn stover, wheat straw, yard waste, leaves, waste paper, maple, and pine — under both liquid and solid state anaerobic digestion (AD). Co-digestion of yard and food waste was also tested, which greatly increases both methane yield and

productivity by volume, and it also allows farmers to take advantage of feedstocks that have zero or negative costs.

To assess the potential of the 4-in-1 system, a 300-gallon modified fixed-dome digester was installed and operated in a greenhouse. During one year of operation, the system performed successfully while the temperature was above 20°C (168 days), indicating such a system can operate for half the year in a temperate climate. Additional improvements are needed to increase the digester performance during colder months.

In July 2009, a pilot-scale biodigester was set up at the Family Farm Field Day held near Mt. Hope. Amish farmers expressed interest, and lab-scale digestion tests of horse mulch and yard waste indicated that feed materials accessible to the Amish community could be used in the biodigesters. Farmers could thus play a leading role in sustainable energy production, which they could use on-farm for their own economic benefit, as well as the state’s. On the other hand, the results from the 300-gallon dome digester suggest that it could be combined with additional conservation measures related to water quality trading. Farmers have requested that water quality trading credits be combined with greenhouse gas credits so that these efforts are complementary.

OARDC is collaborating with Quasar Energy Group to build a combined liquid to solid-phase anaerobic digestion facility for biogas production from municipal and agricultural waste in Zanesville, for which a patent has been applied. Quasar also plans to construct a large-scale modified 4-in-1 sustainable energy system (digesters and greenhouse).



Yebo Li

Chinese farmers use an integrated greenhouse agro-ecosystem known as “4-in-1,” which uses on-farm feedstocks and animal waste to produce biogas as a sustainable energy source.

## Improving information gathering to better manage invasive plants

John Cardina, Horticulture and Crop Science  
Charles Goebel, School of Environment and Natural Resources  
Andrew Michel, Entomology

Exotic plant species invasions cause large-scale and irreversible environmental damage costing the United States over \$120 billion annually. Controlling these weedy species in natural areas is very difficult and expensive, and removing all of them is impossible. Privet is a woody landscape plant that has escaped into forests, where it smothers out desirable plants that provide better food and homes for wildlife.

This project aimed to collect data on privet that would provide land managers with better information about how invasive plants enter and move through the forest in order to control problem species more efficiently, protect sensitive sites, and stop re-infestation. The research team took samples in Wooster Memorial Park from the oldest plants and used annual rings to establish their ages. DNA fingerprinting determined the genetic relation between plants in different patches, which were compared with out-of-state plants to assess if related plants had moved long distances to invade the area.

This research is one of the first attempts to combine information about age and genes to construct maps showing the history of invasive plant movement into a natural area. The age and DNA fingerprinting results show a pattern of privet invasion across states and within Wooster Memorial Park. From 1971 to 2006, the data show an early infestation point, a lag phase with few new patches, a period of high infestation, and eventual tapering off after 2007. The maps show that the first patches to invade were along forest edges, suggesting they might have been introduced by birds or other animals. Open sites were also preferred, possibly due to greater light and lack of competition from other plants.

Results of the genetic analysis suggest that privet was introduced and first naturalized in eastern states and moved west over time. There is no clear pattern of movement through the park, such as along streams or

John Cardina



Exotic plant species invasions cause large-scale and irreversible environmental damage costing the United States over \$120 billion annually.

trails, nor is there a clear pattern of genetic relations among patches that would suggest spread from one or a few focal points. This indicates that each new patch was a random infestation, probably resulting from seeds spread by birds and other animals.

The next step is to overlay the maps of patch age and genetic relatedness on maps showing historical land use in the park. This will help explain why there was a huge increase in the number of patches beginning around 1990, and how changes in land management lead to plant invasions. Molecular analysis methods can be used to study privet invasions in other parks and determine if the patterns of invasion in Wooster Memorial Park are the same elsewhere, leading to specific management approaches. Furthermore, similar methods can be used to reconstruct the invasion history of other plants, especially more recent invaders that are still expanding across the landscape. Finally, these methods will be used as part of an effort to understand how global climate change is likely to influence the spread of new weedy and invasive plants into Ohio's farms and natural areas.

# Controlling plant disease by understanding fungal and rice interactions

Guo-Liang Wang, Plant Pathology

David Mackey, Horticulture and Crop Science

Thomas Mitchell, Plant Pathology

Plant diseases are one of the main limiting factors in crop production worldwide, causing billions of dollars in yield loss and tremendous human suffering annually. Resistant plant varieties are the most effective and economical way to control plant diseases. However, due to pathogen instability, most elite resistant cultivars are short-lived and become susceptible shortly after release. A thorough understanding of the mechanisms of plant/pathogen interactions and the host's defensive responses to diverse pathogens is essential for developing new approaches to effectively control plant diseases and breed long-term resistant cultivars.

The goal of this interdisciplinary project was to understand the molecular events in plant-fungal interactions and develop novel strategies to effectively control fungal diseases in crop plants. Rice was chosen because it is one of the world's most important food crops and has been used as a model for molecular plant pathology studies in cereal crops. Rice blast is one of the crop's most devastating diseases and occurs in virtually all rice-growing areas, causing periodic epidemics. Significant progress has been made in isolating resistance genes in rice and rice blast's avirulence genes. However, the molecular basis of the interaction between these genes is unclear.

Specifically, the study aimed to confirm the interaction between the avirulence fungal gene and its interacting genes in rice cells; characterize the function of the interacting genes in the rice plant's defense response to the blast fungus; and investigate the variation and recognition specificity of the avirulence gene in the natural populations of rice blast.

The team found that the avirulence gene was secreted from the blast fungus to rice cells through its penetration structure and that this gene interacted with two rice genes. The avirulence gene suppressed the activity of both rice genes. In return, these genes modified the avirulence gene, leading to its degradation in rice cells. In addition to its normal activity, the gene also had a virulence function,

which interfered with the rice plant's resistance level. Blast inoculations showed that silencing both interacting genes led to enhanced susceptibility to the pathogen, pointing to their role in rice resistance. To understand the association between the avirulence gene's structure and its virulence, the team used sequencing analysis, which indicated that different mutations can change the gene's function in the field. The preliminary data generated by this project was used to write a successful grant awarded by the National Science Foundation.

This project could have broad impacts on plant disease control in rice and other cereal crops. The team identified two new targets in rice of the avirulence gene and revealed their role in the rice plant's defense. Manipulating these two rice genes could contribute to the development of cultivars resistant to rice blast that can be widely applied and retain their resistance over the longer term. Developing these improved cultivars could potentially enhance the lives of the 50 percent of the world's population that relies on rice as a nutritional, financial, and social lifeline.

Plant diseases are one of the main limiting factors in crop production worldwide.





## Saving Ohio's ash trees by understanding emerald ash borer genomics

Omprakash Mittapalli, Entomology  
Pierluigi Bonello, Plant Pathology  
Daniel A. Herms, Entomology

Since its accidental introduction from eastern Asia in the 1990s, the emerald ash borer has killed millions of ash trees in both natural and managed landscape settings in North America. Because of its devastating economic, social, and environmental impacts, the insect continues to threaten the survival of all major North American ash species, including green, blue, white, and black ash. According to data from the U.S. Department of Agriculture's (USDA) Forest Inventory, there are 3.8 billion white ash trees in Ohio forests, making it the fourth most abundant tree species in the state, with standing timber valued at more than \$1 billion.

There is no literature to date that describes the insect's physiological, biochemical, or molecular processes in relation to its aggressiveness. Here, the research team applied state-of-the-art genomics approaches aimed at deciphering the genetic makeup of the insect and elucidating the basic processes that help it successfully adapt in North America.

Newer-generation sequencing was used to obtain about 60,000 high-quality expressed sequence tags (ESTs, or portions of genes that are expressed in a cell) for the emerald ash borer's midgut and fat body larval tissues. These tissues are vital for an insect's survival, as they deal with digestion, energy metabolism, and overcoming plant toxins. Among these ESTs, 36 percent of the midgut and 38 percent of the fat body sequences were similar to

Because of its devastating economic, social, and environmental impacts, the emerald ash borer continues to threaten the survival of all major North American ash species.



Omprakash Mittapalli

proteins in other insects. A high number of digestive and detoxification proteins were also retrieved. Furthermore, the midgut sequences revealed genetic coding for cell-wall degrading enzymes. A significant number of mutations were also found, along with other molecular markers. An initial assessment of detoxification and antioxidant genes revealed distinct expression patterns at the tissue level and during different developmental stages.

The team has developed a huge database for emerald ash borer genes, which lays the foundation for several future studies. For example, the team is currently performing experiments to gain insights into differential gene expression patterns among emerald ash borer larvae around the world that feed on different ash species. These results will provide first-hand knowledge as to how the insect deploys genetic strategies to overcome the ash tree's defenses, leading to its successful adaptation in North America. Furthermore, these results shed light on susceptible insect-specific targets in futuristic targeted control strategies (e.g. using RNA interference), in which disrupting specific insect genes can retard insect development and thereby enhance plant health.



---


The OARDC SEEDS Competitive Grants Program has allowed OARDC to leverage resources, invigorate research, and place investigators in a position to gain extramural funding, necessary to address state, national, and international food and fiber issues. On average each OARDC faculty member generates in excess of \$217,000 in external funding annually. Addressing the vast opportunities of Ohio's largest industry is the ultimate goal of SEEDS. SEEDS promotes excellence consistent with the mission and vision of OARDC and encourages connections across disciplines, with industry and other stakeholders. — *Steven A. Slack, Associate Vice President for Agricultural Administration and Director, OARDC*

---

# Matching and Industry Small Grant Competitions





A photograph of two scientists in white lab coats working in a laboratory. They are standing next to large, circular, shallow tanks, possibly for growing plants or algae. The scientist on the left is holding a long, thin rod or pipette, and the scientist on the right is looking down at something in the tank. The background shows more of the laboratory environment with various pieces of equipment and structures.

**The Matching and Industry Small Grant Competitions are specifically designed to develop partnerships with private industry and non-profit foundations. Industry Small Grants provide up to \$6,000 from the SEEDS program while Matching Grants provide up to \$50,000. Investigators are required to obtain a dollar to dollar match for both of these competitions.**



---

SEEDS has laid the groundwork for a scientific breakthrough in understanding the main routes of antibiotic resistance

spread to humans and has facilitated the dissemination of these findings to a larger audience. My first grant allowed me to collaborate with the U.S. dairy industry, which led to national conference presentations, publications, and in helping to draft a nationwide bill on antibiotic resistance. My second SEEDS grant funded a project that ultimately showed that childbirth, food, and environmental contact can all lead to antibiotic-resistant bacteria transmission. These findings redefined the scientific approach to these issues. Without the SEEDS grants, it is possible that this work could never have been funded, which shows SEEDS' critical role in supporting cutting-edge scientific research.

— *Hua Wang, Food Science and Technology*

---

# Contrasting the effects of organic vs. inorganic fertilizers on plant health

Parwinder S. Grewal, Entomology



Parwinder S. Grewal

Compared with the chemical fertilizer, the organic fertilizers Cockadoodle Doo, Corn Gluten, and Nature's Touch with enzymes generally resulted in better turf quality and higher shoot growth.

Interest in organic lawn care practices has increased in recent years in the United States. This study compared the effect of 11 organic fertilizers, applied at manufacturer's recommended rates, on tall fescue (turfgrass) infected with the fungus *Neotyphodium coenophialum*, in the greenhouse. The impacts the research team considered included quality based on greening effect, shoot and root growth, shoot nutrient content (reflecting nutrient uptake), and alkaloid content, which is an indication of insect resistance. Measurements were taken of turfgrass quality on a scale of 1–9 on a weekly basis, shoot and root growth monthly, and shoot contents of macro- and micronutrients and of various alkaloids after four months. The researchers compared these effects to those of a chemical fertilizer, Scott's Turf Builder.

The results indicated that the fertilizers Corn Gluten and Cockadoodle Doo generated the highest turfgrass quality and shoot growth, but Nature's Touch with enzymes enhanced root growth. Compared with the chemical fertilizer, the organic fertilizers Cockadoodle Doo, Corn Gluten, and Nature's Touch with enzymes generally resulted in better turf quality and higher shoot growth. Although Cockadoodle Doo, Vigoro, and Scott's Turf Builder resulted in higher macronutrient content in turfgrass shoots, there was no correlation between the fertilizers' nutrient content and the shoots' nutrient content four months after application. Significant differences were found for all measured alkaloids among the 13 treatments, but these differences varied with the fertilizer.

Overall, organic fertilizers produced higher turfgrass quality, growth, and insect resistance capacity (alkaloid content) compared with the standard chemical fertilizer, Scott's Turf Builder. On the basis of the high to excellent turfgrass greening quality ratings, root to shoot ratio, shoot nutrient and alkaloid content in this study, the team concluded that Cockadoodle Doo, Vigoro, Corn Gluten, and Nature's Touch with enzymes are relatively superior organic fertilizers. Future research should focus on the evaluation of these fertilizers under field conditions, including different soil types and turfgrass species and cultivars.



## Supporting aquaculture growth in Ohio by developing and using sustainable feed

Hanping Wang, OSU South Centers at Piketon

Aquaculture is the fastest-growing animal food sector in the United States and the world, and currently demands 25 percent of global fish meal and 36 percent of global fish oil supplies. As fish meal availability declines, soybean meal represents great potential as a protein replacement in fish feed. Currently the Ohio aquaculture industry has an estimated annual economic impact of \$50 million. Many Ohio aquaculture operations are looking to increase profitability and maintain family farms. Farming high-dollar fish species and bait fish represents potential opportunities. Yellow perch is the most popular high-value aquaculture species in Ohio, and Ohio ranks fourth in sales of bait fish in the nation.

The overall goal of this project — the Ohio Soy-Aqua Research and Development Initiative — was to support the growth and sustainability of Ohio's rapidly expanding aquaculture industry, and in turn, develop new and local markets for Ohio soybeans. This project aimed to determine whether genetically improved yellow perch produced by OSU South Centers breeding programs and reared with fish meal-based feeds performed well when their feed was substituted with soybean meal diets. Furthermore, the project assessed whether genetically improved fish have sufficient genetic variation for enhanced growth, feed intake, and feed efficiency to occur with both fish meal and soybean meal diets. The research team also evaluated the effects of soybean meal and fish meal diets on the growth performance and feed efficiency of spotfin shiners to determine their potential as bait fish. Finally, to improve outreach to Ohio's aquaculture industry, a Soy-Aqua Initiative bus tour provided educational materials to aquaculture farmers and raised awareness of the Initiative.

Based on the diet experiments, genetically improved yellow perch reared with fish meal diets performed well when their diets were changed to soybean meal. The researchers also concluded that sufficient genetic variation existed for growth and feed efficiency to improve under both fish meal and soybean meal diets. However, the soybean meal diet resulted in higher feed intake but slower growth, which indicates that it was processed less efficiently than the fish meal diet.

Based on these results, the team concluded that increased soybean meal use in feeds does not compromise genetic improvements in yellow perch. Fish selected for more robust growth under a fish meal diet are just as likely to see improved growth and feed efficiency under a soybean meal diet as those selected specifically for robust growth under a soybean meal diet.

Currently the Ohio aquaculture industry has an estimated annual economic impact of \$50 million.

The two diets' effects on growth performance and feed efficiency in spotfin shiners showed that fish fed with soybean meal diet had a higher growth rate than other groups, indicating spotfin shiners do not require fish meal for robust growth. Soybean meal thus has great potential for use as bait fish feed. The evidence that the soybean meal diet supported slower growth and higher feed intake suggests that simultaneous selection for fast growth and reduced feed intake is needed in genetically improved yellow perch and other aquaculture species. The team's next step will be to test if feed intake and body weight variations are correlated in yellow perch that are genetically improved for soybean meal utilization efficiency, and to develop criteria to improve feed intake of soybean meal in fish.



Hanping Wang

## Advancing the development of a new biopesticide

Brian B. McSpadden Gardener, Plant Pathology  
Michael J. Boehm, Plant Pathology  
Pierce A. Paul, Plant Pathology

Fusarium head blight (FHB) is a devastating disease affecting wheat and barley, causing hundreds of millions of dollars of damage annually in the United States. Despite substantial efforts, plant breeding and chemical fungicides have achieved only limited success in controlling the disease. Thus, developing a reduced-risk biopesticide — made from natural, rather than synthetic, materials — could provide a valuable tool for managing FHB.

The yeast strain *Cryptococcus flaveus* OH182.9 represents a compelling biopesticide technology with strong potential for controlling FHB. The patent for OH182.9 is currently licensed to the company Sci Protek, which is looking to develop the strain commercially as a biopesticide. To do so, key data and new analytical tools are needed. To advance the product towards U.S. Environmental Protection Agency (EPA) registration, the project team set out to characterize the genome of OH182.9, develop a strain-specific test to track the strain, and evaluate the spread of OH182.9 in a field trial.

The team successfully completed the sequencing and assembly of the OH182.9 genome. Researchers selected five different target genes for marker development based on their uniqueness and surrounding sequences. In the end, the team could reliably detect OH182.9 strain C3 at populations as low as 1 part per million on wheat heads.

In the field study, the team discovered a slow but measurable spread of strain C3 beyond the initial inoculation points. Specifically, populations of C3 remained constant in the inoculated plots through the 44-day test period. Spread from the inoculated plots was slow but steady, being first detected 10 days after inoculation and then detected as far as 20 meters from the point of inoculation after 44 days. By the end of the experiment, C3 could be detected on over 50 percent of the non-inoculated samples, with



Brian B. McSpadden Gardener

colonization being most evident at distances of less than 10 meters from the inoculated plots. These data indicate that the inoculated biocontrol agent will spread beyond the application point, but will rarely colonize wheat head at levels exceeding 10 percent of the inoculated dose.

Future work will focus on establishing the biological significance of this spread. The team plans to combine assessments in other field trials with analysis of the harvested wheat and more extensive studies of the microbial communities colonizing wheat heads before and after inoculation. This work will help determine whether or not the use of C3 presents any significant environmental or food safety risks, and thus its role in the development of safe and effective biopesticides.

Developing a reduced-risk biopesticide — made from natural, rather than synthetic, materials — could provide a valuable tool for managing Fusarium head blight.

# Reducing pesticide use through targeted application in Ohio orchards and nurseries

Erdal Ozkan, Food, Agricultural, and Biological Engineering

Because of great variability in canopy structure and foliage density in orchards and nurseries, conventional pesticide spray systems and methodologies are inefficient and often cause excessive pesticide use. Precise pesticide application is necessary for high crop yields, high production quality, and economic feasibility. Furthermore, the unnecessary overuse of pesticides can contaminate the environment and pose a hazard to both workers and livestock.

To improve pesticide application efficiency, the research team developed an “intelligent” air-assisted sprayer prototype — the first of its kind in the United States — to discharge pesticide sprays that match target tree characteristics in real time. The sprayer integrates a high-speed laser scanning technology, a custom-designed sensor-signal analyzer, an automatic variable-rate controller, variable-rate nozzles, and a multi-channel air-assisted delivery system. The laser sensor unit characterizes the occurrence, height, and width of tree canopies with high detection resolution. Then, the automatic controller manipulates the spray outputs of individual nozzles. A computer program, including a unique foliage density

algorithm, was developed to calculate sectional canopy volumes and foliage densities for the corresponding nozzles, and then synchronize the spray outputs with the laser sensor detection.

Field experiments demonstrate that the new intelligent sprayer has the capability to achieve variable spray rates for different canopy structures and foliage densities of any tree up to three meters in height. Compared to conventional sprayers, the intelligent sprayer is more consistent in spray coverage and deposition inside canopies at different growth stages. Moreover, the intelligent sprayer can reduce spray volume by 47 to 73 percent, with much less pesticide loss on the ground, through tree gaps, and in the air. By accurately targeting spray applications, this new technology will help growers prevent excessive pesticide use and thus reduce production costs, worker exposure to pesticide risks, and adverse environmental contamination.

Future work will focus on reducing the sprayer’s cost and testing it in commercial nurseries and orchards in Ohio, with the aim of farmers eventually adopting the new technology.

Erdal Ozkan



Precise pesticide application is necessary for high crop yields, high production quality, and economic feasibility. Furthermore, the unnecessary overuse of pesticides can contaminate the environment and pose a hazard to both workers and livestock.



## Examining the potential of lowering cholesterol with soy saponins and garlic extract

Robert A. Disilvestro, Human Nutrition

Cardiovascular disease is the number one cause of death in the United States. Plasma cholesterol readings are one of the most reliable predictors of cardiovascular disease. Therefore, lowering cholesterol readings should lower the risk of cardiovascular disease. Although drugs can be used to lower plasma cholesterol readings, drug side effects and cost make this approach less than ideal.

This project looked at an alternative, natural treatment based on a garlic product combined with an extract derived from soybeans, which could dramatically reduce both costs and unpleasant side effects. The extract is high in molecules called saponins. Preliminary research in mice showed that soy saponins have a cholesterol-lowering effect. Moreover, a significant effect was seen when saponins were combined with a specific garlic extract supplement. This project aimed to see if the same results could be obtained in humans with moderately high cholesterol readings.

An Ohio company currently prepares the highest-quality supply of soy saponins in the world, but the market for this product is scarce. Saponins can be prepared from soy product left over from soybean processing. Thus, demonstrating the health benefits of saponins could create a new market for Ohio soybeans and have positive economic implications. In addition, such research could have profound health benefits for the residents of Ohio and elsewhere.

The research results indicated that neither the saponins alone, nor with the garlic product added, consistently lowered cholesterol readings in human subjects. However, the conditions of the mouse study were different — their



Robert A. Disilvestro

plasma cholesterol readings were raised through a diet extremely high in cholesterol and saturated fat. In the human study, cholesterol readings were moderately high due to a variety of genetic, dietary, and other lifestyle factors. Here, the readings were not lowered by the saponins and garlic. The hypothesis that the saponin and garlic effect seen in mice would carry over to any state where blood cholesterol was elevated was not borne out.

On the positive side, the saponins raised plasma contents of an antioxidant defense molecule that may reduce symptoms of rheumatoid arthritis. In addition, the garlic product, although it did not lower cholesterol, was found to beneficially affect some other blood measures. If these positive effects of the saponins or garlic can be increased by combining them with one or two other nutritional products, a new drug application would be possible. Also, the saponins did not adversely affect liver or kidney function. While the original hypothesis behind the project was not validated, the researchers aim to secure funds to explore the other potential health benefits of saponins and garlic.

If the positive effects of the saponins or garlic can be increased by combining them with one or two other nutritional products, a new drug application would be possible.

## Developing new tools to manage weeds in brambles

Douglas Doohan, Horticulture and Crop Science

Bramble fruit demand has increased rapidly in Ohio due to the public recognition of the health benefits of consumption, which include high levels of antioxidants. However, inadequate weed control is the number one production problem that limits the bramble industry's expansion in the state. Perennial weeds interfere severely with maintenance and harvest. An effective weed control program should include seedling weed control during the planting year and perennial weed control in subsequent years, but the brambles' superficial root system and the fact they are a perennial crop limit the potential for mechanical weed control. The research team's experience indicated that these obstacles could be overcome by using certain herbicides. The objective of this project was to develop crop safety and performance data needed to support the licensing of effective herbicides with the U.S. Environmental Protection Agency (EPA).

Inadequate weed control is the number one production problem that limits the bramble industry's expansion in the state.

Past research has shown that crop rotation, fallowing, and other sustainable weed control practices suited to annual crops cannot be used in established bramble fields. In order to identify herbicides for potential use on bramble crops, the tolerance of blackberries and red and black raspberries was evaluated in a greenhouse experiment. Four post-planting and six pre-planting herbicide treatments, with both leaf and soil applications, were evaluated. The data demonstrated that tolerance is almost always greatest in blackberries, and the safest treatments were the herbicides clopyralid (Stinger), and pendimethalin (Prowl). In general, brambles recovered from any damage by 21 days after treatment.

The second part of the study aimed to determine the best herbicide to provide early-season weed control and



Douglas Doohan

maximum crop safety in newly planted brambles. Five post-planting herbicide treatments were applied to one-year-old red raspberries and blackberries, along with an untreated control. The same treatments were reapplied in each of three years over the same plots. The results indicated that the herbicide terbacil (Sinbar), currently not recommended for use with newly planted berries, provided the best overall weed control.

Clopyralid is a highly effective herbicide and has great potential to prevent reinfestation by perennial weeds, but uncertainties about crop tolerance to the herbicide still persist. The third and final study aimed to resolve those uncertainties, determining optimum rates and timing of clopyralid applications for crop safety and thistle control. Two-year-old red raspberries were treated four times during the year and at two different rates, along with an untreated control. The results affirm that clopyralid is a safe herbicide for use on raspberries.

This project provided the basis for developing strategies that consistently and efficiently control weeds. Clearance requests for several new herbicides were submitted to the Interregional Research Project No. 4 (IR-4), which is a federal cooperative program that helps producers obtain clearances for pest control materials on minor crops. Herbicide performance data were also provided to the IR-4 database. This research has already had a positive impact on weed control, especially among new producers who can plant their brambles using good weed control methods from the outset.

## Testing the potential of growing Giant reed (*Arundo donax* L.) for biomass production in Ohio

David Barker, Horticulture and Crop Science  
R. Mark Sulc, Horticulture and Crop Science

Giant reed is a grass species with high biomass production value and could possibly be a sustainable energy source. This resilient species has C4 physiology, which means it loses less water than plants — e.g. wheat — during adverse conditions such as drought and high temperatures, making it potentially productive during the Ohio summer. Giant reed is not native to Ohio, but has shown it can survive Ohio's cold winters. Previous research indicates that giant reed can reproduce from its own underground stems, or rhizomes.

The goal of this research project was to make the case that Giant reed can be successfully grown and used for future biomass research in Ohio. The objectives were to first, measure the transplant success of Giant reed from rhizomes; second, to measure the relationship between plant density and biomass; and finally, to measure transplant success under various establishment options.

Giant reed rhizomes were replanted into an area that had been rotary-tilled. At each planting date, rhizomes were planted at either high density or low density. Each plant

was fertilized, the experimental area was covered with mulch for weed control, and no irrigation was used.

The result from the first objective was that Giant reed was easily established from rhizomes, although earlier (May) transplanting was more successful than later (in June). Second, the team discovered that the higher-density planting resulted in a thicker final canopy than at low density; it would take three to four years for the low-density transplants to thicken to a satisfactory canopy. Finally, the researchers discovered that Giant reed also established from fall-planted stems, which may be more cost-effective than the labor-intensive method of planting rhizomes.

All plants survived the winter and grew vigorously in spring 2011. Giant reed achieved exceptional yields, density, and height. Research still needs to be conducted on basic agronomic questions, such as fertilizer response, weed control options, and extrapolation of these establishment methods to a field scale, so that Giant reed's use as biomass can be more fully explored.



David Barker

The researchers discovered that Giant reed established from fall-planted stems, which may be more cost-effective than the labor-intensive method of planting rhizomes.



## Understanding fungicide insensitivity on pumpkins infected with powdery mildew

James R. Jasinski, Ohio State University Extension

Sally A. Miller, Plant Pathology

Robert J. Precheur, Horticulture and Crop Science

Landon H. Rhodes, Plant Pathology

Richard M. Riedel, Plant Pathology

Pumpkins sold for the Halloween holiday are an important autumn crop for Ohio growers, bringing in an estimated \$22.5 million in 2009. However, the disease powdery mildew (*Podosphaera xanthii*) causes significant yield and quality reduction every year in pumpkin and other cucurbit crops (e.g. melons, squash, and cucumbers). Over the past few years, anecdotal evidence from northern Ohio growers has suggested that specific fungicides were losing their effectiveness in controlling powdery mildew (PM) infections in pumpkins. This may be a sign the pathogen has developed insensitivity to these fungicides. Past research from Ohio and around the north central and northeastern United States has shown that the strobiluron class of fungicides tends to be ineffective at controlling PM, but demethylation-inhibiting (DMI) fungicides can better control diseases when used at higher rates.

This experiment was designed to validate previous findings that the cucurbit PM pathogen is not fully controlled by specific fungicides used in Ohio. The project tested fungicide-treated pumpkin seedlings that were raised in a greenhouse, transported to the field for PM inoculation, and then taken back to the greenhouse. The research team observed over time the seedlings exposed to PM spores at five locations around Ohio to determine which commonly used fungicides effectively controlled PM development on pumpkin leaves. All fungicides were applied at high rates to a PM-susceptible and a PM-tolerant cultivar, and there was also an untreated control group of seedlings.

Powdery mildew development and severity varied by location, cultivar, and fungicide, which is reflected in a



Robert J. Precheur (left) and James R. Jasinski

commonly used measure — the Area Under the Disease Progress Curve (AUDPC). Based on the AUDPC values at all five locations, only four treatments performed significantly better on both the susceptible and PM-tolerant cultivars than the untreated seedlings.

The research determined that the fungicide Quintec controlled PM nearly ten times better than the next-best fungicides evaluated, regardless of cultivar susceptibility, even under very heavy PM pressure. To combat PM, this fungicide should be incorporated into the rotation early in the season and used according to label restrictions, although it will not control other cucurbit diseases. Certain other fungicides controlled PM well and should be considered as rotational partners with Quintec. To minimize disease resistance, broad-spectrum fungicides need to be tank-mixed with other materials where appropriate.

Future research in this area will concentrate on evaluating different groups of compounds, such as certified organic or fungicides derived from natural organisms, using the same experimental design described in this report. Because PM resistance is a moving target, new products need to be continually tested in order to manage this disease and to sustain pumpkin as a profitable seasonal crop in Ohio.

The disease powdery mildew (*Podosphaera xanthii*) causes significant yield and quality reduction every year in pumpkin and other cucurbit crops.

# Evaluating antimicrobial surface coatings' ability to reduce foodborne bacteria

Kenneth Lee and Elizabeth Grasso, Food Science and Technology

One in six Americans becomes ill each year from foodborne pathogens. Unfortunately, the presence of pathogenic and spoilage bacteria on food processing equipment can lead to food contamination. Regular equipment sanitation is a costly, time-consuming process that results in production losses and may shorten the lifespan of processing equipment. Additionally, research has shown that cleaning agents may not kill bacteria because they are developed to remove food residues rather than bacteria.

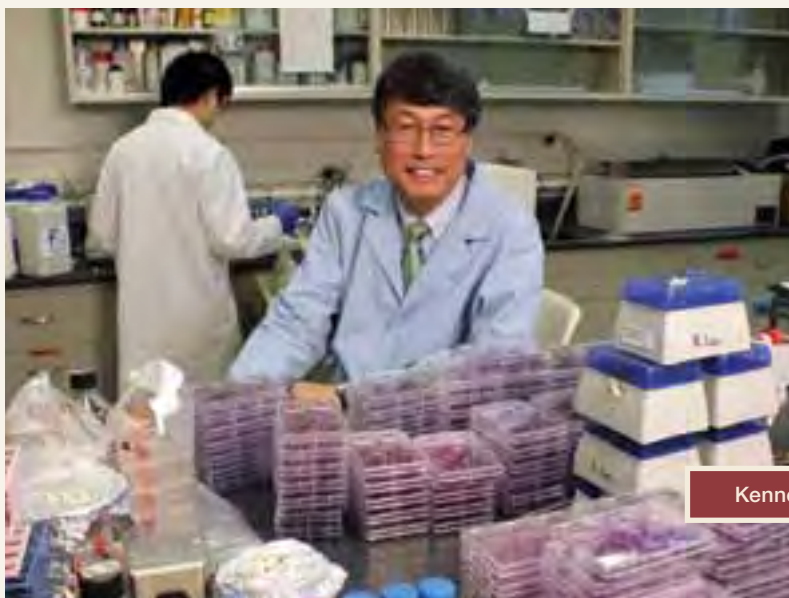
Metallic compounds, such as silver, can effectively inhibit or kill many different bacteria. Combined with these compounds, antimicrobial surface coatings can reduce bacterial contamination of food contact surfaces and thus greatly decrease the potential for foodborne illnesses and product recalls.

This project evaluated the efficacy of four commercially available antimicrobial surface coatings against three nonpathogenic foodborne bacteria. Each coating was applied to individual pieces of stainless steel and then inoculated with a solution containing the three bacteria. The inoculate was covered and allowed to sit for 24 hours at room temperature. Following an initial evaluation, the stainless steel underwent a cleaning cycle using hot water, a base, an acid, and a commercial detergent/disinfectant. Microbial testing was conducted after each cleaning cycle.

A total of one to three cleaning cycles were completed based on the durability of the coating, and all steps were repeated three times.

Before cleaning, the amount of bacteria on the silver coatings ranged from 0.01 to 9.85 log colony-forming units per gram (CFU/g) compared to the untreated stainless steel control piece. Each cycle of the accelerated chemical clean mimicked the conditions seen in approximately two months of real-time cleaning conditions. Following one cleaning cycle, the maximum reduction was 5.4 log CFU/g. Following two cleaning cycles (mimicking 4 months of real-time conditions), three of the four silver coatings were too damaged to continue the study. The remaining coating showed about a 3.5 log reduction from the control. Following three chemically accelerated cleaning cycles, the coating was no longer killing bacteria.

The study's findings show that one of the commercial antimicrobial surface coatings appeared to be effective until it flaked off of the stainless steel piece following two cleaning cycles. More durable coatings are necessary to help reduce pathogen contamination on food processing equipment. The manufacturers were contacted with the results of this study. The next step is to investigate other types of antimicrobial surface coatings to determine their effectiveness in killing the bacteria that cause foodborne illnesses.



Kenneth Lee

Antimicrobial surface coatings can reduce bacterial contamination of food contact surfaces and thus greatly decrease the potential for foodborne illnesses and product recalls.

## Improving Ohio produce by reducing foodborne pathogens with e-beam technology

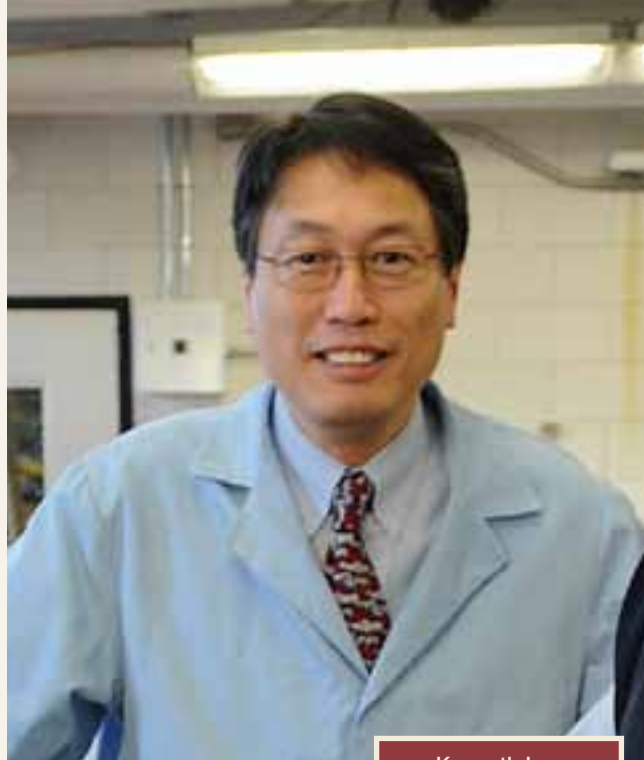
Kenneth Lee, Food Science and Technology

Ohio is an important supplier of fresh produce. Because produce receives little to no processing prior to consumption, many spoilage or pathogenic microorganisms can remain on these products. Recently, romaine lettuce sold in Ohio was recalled because of *Escherichia coli* (*E. coli*) bacterium contamination, which caused illnesses in at least 19 people in three states. Produce tainted with viruses, such as norovirus or Hepatitis A, has also been associated with illness outbreaks.

Nonthermal processing technologies, such as electron beam (e-beam) irradiation, have effectively inactivated bacteria in fresh produce and can make these products safer to consume, prolong the shelf life, and maintain quality characteristics. However, the effect of e-beam on viruses has yet to be established.

To determine e-beam's potential to improve the safety of Ohio's produce, the research team evaluated the effect of e-beam processing on microorganisms on fresh produce. The first study aimed to determine the effectiveness of e-beam on naturally occurring bacteria and *E. coli* inoculated onto fresh-cut cabbage. The second study assessed the effectiveness of e-beam on norovirus inoculated into fresh-cut cabbage, strawberries, and liquid model systems to see if these systems protected the virus. For e-beam treatment, doses of up to 4 kilograys (kGy) were used for the bacterial studies, and up to 12 kGy were used to treat liquid and food samples in the viral studies.

In the first study, the e-beam reduced populations of *E. coli* on fresh-cut cabbage to safe levels after 4 kGy of treatment. Naturally occurring bacteria on fresh-cut cabbage were reduced to undetectable levels. These results suggest that



Kenneth Lee

e-beam is effective in reducing pathogens and naturally occurring bacteria to harmless levels, thus ensuring a product is safe to consume and has an extended shelf life.

In the second study, cabbage and strawberry samples, as well as a nutrient-rich cell culture medium, were resistant to e-beam treatment. Even after 12 kGy of treatment, thousands of infectious virus particles remained. Doses higher than 4 kGy are not recommended for fresh produce because color loss, softening, and off flavors can occur. These results suggest that viruses are much more resistant than bacteria to e-beam irradiation, which occurs because viruses are a thousand times smaller than bacteria, making them more difficult to hit with e-beam. Also, resistance increases if the virus is present in complex liquid media or food products.

Based on the data, e-beam is a promising technology for reducing or eliminating bacteria on fresh produce, whereas viruses are much more resistant to treatment. Future work with bacteria and e-beam can include selecting additional produce for treatment and evaluating e-beam's effect on other pathogenic bacteria (e.g. *Listeria monocytogenes*, *Salmonella*). Promising e-beam research on viruses is still possible, such as evaluating the effect on other foodborne viruses (Hepatitis A) and determining if altering e-beam parameters (e.g. voltage or current) can enhance viral inactivation in foods.

Nonthermal processing technologies, such as electron beam (e-beam) irradiation, have effectively inactivated bacteria in fresh produce and can make these products safer to consume and prolong the shelf life.





---

SEEDS has been an integral part of my research program since its inception.

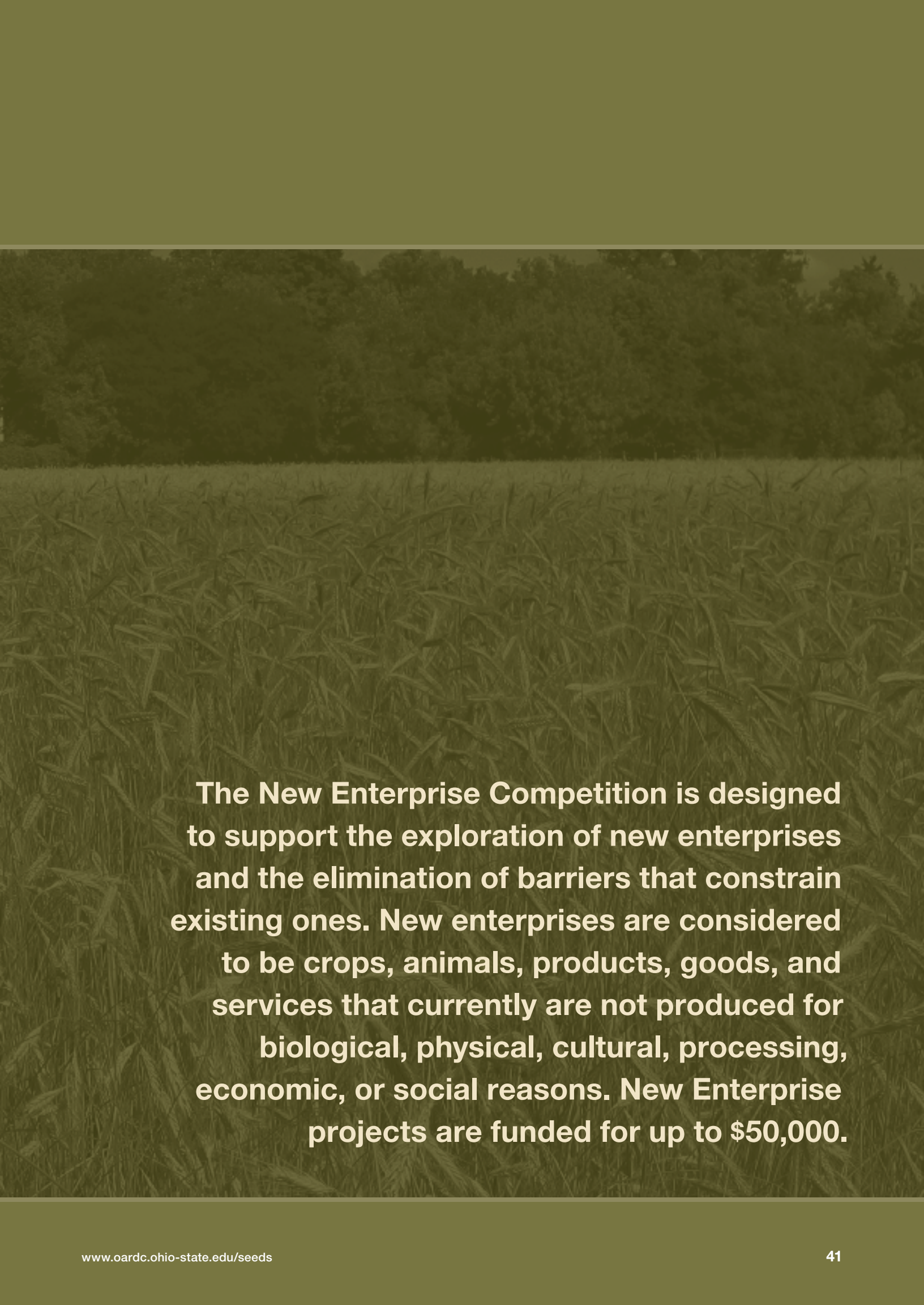
My first SEEDS grant 15 years ago provided funding for my earliest interdisciplinary venture at Ohio State, which led to a long and productive research program that funded the training of several MS and PhD students and provided solutions to real-life economic problems. A more recent SEEDS interdisciplinary grant supported a new emphasis in my laboratory on disease management in greenhouse production systems. Our preliminary research results from the SEEDS grant were instrumental in our success in obtaining a 4-year, \$2 million grant from the U.S. Department of Agriculture in 2010. We have also obtained a number of Matching and Small Industry Matching SEEDS grants over the years, which supported research that directly contributed to developing practical solutions for disease problems identified by our stakeholders. It is very difficult to obtain grant funding, with success rates commonly of 5–10 percent. I am certain that I would not have been able to develop a program to meet stakeholder needs and contribute to the advancement of knowledge in plant pathology without SEEDS.

— Sally Miller, *Plant Pathology*

---

# New Enterprise Competition





**The New Enterprise Competition is designed to support the exploration of new enterprises and the elimination of barriers that constrain existing ones. New enterprises are considered to be crops, animals, products, goods, and services that currently are not produced for biological, physical, cultural, processing, economic, or social reasons. New Enterprise projects are funded for up to \$50,000.**





---

The SEEDS program has been essential to the success of my research program over the years. My first funded project, awarded in 2001, provided the necessary funds to generate sample resources and techniques in my lab that would help launch the molecular microbial community profiling work for which my lab has developed an international reputation. Further funding in 2004 and 2009 provided my lab with the opportunity to develop additional expertise in genomics that have kept my lab competitive, despite rapid changes in science and technology. Without funding from SEEDS, I would not have been able to maintain an active program and compete successfully for large, interdisciplinary grants from various U.S. Department of Agriculture programs. — *Brian McSpadden Gardener, Plant Pathology*

---

# Creating an organic wheat production system in Ohio

Deborah Stinner, The Organic Food and Farming Education and Research Program (OFFER)  
Clay Sneller, Horticulture and Crop Science

Ohio imports organic bread wheat for milling from other states. With the growing popularity of organic foods nationwide, several regional millers, bakers, and processors of specialty bread and noodle products would prefer to source hard wheat grain from regional farmers. However, processors either are unable to find locally produced grain, or available products do not meet quality targets. A local, organic, hard wheat management system could be profitable for farmers and millers, benefit the environment, and improve consumer health.

Three key questions need to be addressed before a local and organic wheat production system can be established in Ohio. (1) Which wheat cultivars will provide an optimal combination of productivity, crop quality, and resistance to disease and insect pests? (2) Given the best wheat genetics, which fertility and pest management strategies will meet producer, processor, and consumer quality standards the most cost effectively? (3) How can profitability be optimized along the organic production chain, so that all members have a fair share of the profits? The specific objective of this project was to address the first question so that subsequent research can begin to address the broader issues of management and profitability.



Deborah Stinner

The project evaluated new cultivars of hard white and red wheat that were under organic production in Wooster based on several attributes that are essential for marketing and safety. Researchers tested whether the cultivars had the necessary characteristics for quality bread dough, determined their disease resistance, and measured their concentrations of deoxynivalenol, a toxin produced by the pathogen that causes head scab on wheat.

Of the eight hard white wheat cultivars, Clarks Cream had the best overall gluten quality and visually had relatively lower head scab infection than the other hard white wheat cultivars. However, its yield was not as high as some of the other cultivars, and its flour contained deoxynivalenol above the concentration level recommended by the U.S. Food and Drug Administration (FDA). Another cultivar produced greater yields than Clarks Cream but would likely require added fertilization to increase protein and gluten quality. Its flour also contained excessive deoxynivalenol levels. The trial included a new line of soft red winter wheat developed at OARDC with higher gluten content and promising baking qualities. It had excellent yield and a deoxynivalenol concentration well below the FDA's recommended level.

The three cultivars from this trial that merit further experimentation and evaluation are two hard white wheat cultivars and the high-gluten soft red winter wheat. The latter is of particular interest because of its low deoxynivalenol concentration. This cultivar was grown organically at OARDC Wooster in 2010–2011 for commercial production. The next step is to mill the grain and have bakers evaluate the flour.

A local, organic, hard wheat management system could be profitable for farmers and millers, benefit the environment, and improve consumer health.

# Seed Grant Competition







**The Seed Grant Competition is designed to encourage new and innovative research and to generate the preliminary data needed for successful application to competitive extramural funding sources. Seed Grants are supported at a maximum level of \$50,000.**



---

The SEEDS program has significantly enhanced the research efforts and overall program of my laboratory at OARDC.

Specifically, it has provided the preliminary data needed to seek external competitive funds — such as from the National Institutes of Health. It has enabled us to develop enhanced methods for the detection and surveys of existing or newly emerging viruses, and it has facilitated important industry collaborations and partnerships by supporting development of critical animal disease models and vaccine virus strains, and providing the research data or seed money needed to establish these joint collaborative ventures. The results have benefited Ohio agriculture and both animal and public health. — *Linda Saif, Food Animal Health Research Program*

---

## Gauging the impact of soy consumption on human health

Mark L. Failla, Human Nutrition

Joshua A. Bomser, Human Nutrition

John Gunn, Molecular Virology, Immunology and Medical Genetics

Past research has identified a variety of potential health benefits of soy consumption, including reduced risk of heart disease, osteoporosis, and cancer. As a result, researchers were keen to identify health-promoting compounds in soy products, which could then be used to fortify foods. To date, minimal research had focused on soy saponins and how they promote health. Saponins are a diverse family of chemical compounds present in many plants, with a strong concentration in soybeans. For centuries, Asian medicine has used saponins to treat intestinal ailments and skin infections. Past research has also demonstrated beneficial properties of saponins, which can lead to reduced inflammation, allergies, and cancer risk. However, animal and human studies have shown that saponins are poorly absorbed.

Based on earlier findings, the Ohio State University team hypothesized that soya saponins would decrease the risk and/or severity of gastrointestinal disease caused by infectious bacteria. Thus, the team examined the ability of soya saponins to regulate the adherence and invasiveness of the pathogenic bacterium *Salmonella enteritica* to cells lining the small intestine and thus reduce inflammation.

The research team grew the bacteria in both the absence and presence of soya saponin, and then added them to human intestinal cells. They found that after exposure to concentrations of soya saponin that can be present in the intestine after eating a meal containing soy products, bacterial adherence to the intestinal cells decreased by 50 percent, and the number of bacteria invading these cells decreased by 60 percent.

The next critical step was to develop effective methods to characterize the complete mixture of saponins in soy food



Mark L. Failla

products. The research team collaborated with Drs. Steven Schwartz and Yael Vodovotz in the Ohio State University Department of Food Science and Technology, who were developing an analytical method to investigate the relative stability of saponins during the making of bread enriched with soy and chickpea (another food with high amounts of saponins), as well as their stability and absorptive capacity during digestion of the saponin-containing breads. The various saponin types performed in different ways — some were stable during the bread-making process, but others were lost. In general, the most abundant saponins were stable after simulated digestion, suggesting their potential to promote a healthy gut.

The overall findings suggest that soya saponins have the potential to block bacterial adhesion to the surface of intestinal cells and reduce the risk and severity of gastrointestinal infection. This is similar to the ability of compounds in cranberries to block binding of pathogenic bacteria to the wall of the urinary tract, thereby decreasing the incidence and severity of urinary tract infections. The researchers are now focusing their attention on the health-promoting activities of those saponins in soy and chickpeas that remain stable during bread-making and digestion.

Past research has demonstrated beneficial properties of saponins, which can lead to reduced inflammation, allergies, and cancer risk.



## Examining the effects of pollution prevention practices on environmental innovation

Abdoul G. Sam, Agricultural, Environmental, and Development Economics

Voluntary pollution prevention practices by businesses are an increasingly common feature of contemporary environmental policy, thanks in part to rising public concerns and the passage of the 1990 U.S. Pollution Prevention Act. Ohio is the fourth largest generator of toxic pollutants in the country. In response, the state's Environmental Protection Agency (EPA) has promoted adoption of pollution control practices, including the 2007 Tox-Minus Initiative, a partnership program with Ohio businesses to achieve meaningful reductions in toxic releases across all media within five years.

The purpose of this research was to explore what motivates Ohio businesses to adopt voluntary pollution prevention practices, and the effects of such practices on environmental innovation, which is regarded as the key source of environmental improvements. There is a lack of research exploring the effects of voluntary pollution prevention practices on a business's ability to develop new environmental technologies.

This proposal sought to test two competing hypotheses to gauge the effects of various pollution prevention practices on business-funded environmental innovation. The first hypothesis is that a firm's adoption of pollution prevention practices yields increased incentives for environmental research and development with the aim of reducing costs, and thus leads to more environmental patents. However,

a competing hypothesis would be that a firm's adoption of more pollution prevention practices redirects resources away from environmental research and development toward short-lived environmental improvements, and thus leads to fewer environmental patents.

The project gathered firm-level data over time from several sources and used appropriate statistical techniques to test these hypotheses. The key variables used were the number of voluntary pollution prevention (P2) practices and releases by Ohio businesses over time, and the number of environmental patents, also over time. Several other variables were also incorporated.

The research team's statistical analysis indicates that the adoption of voluntary pollution prevention practices does stimulate environmental research and development. However, the estimated impact of mandatory pollution regulations is between ten and seventeen times stronger than that of voluntary adoption. The analysis therefore suggests that while the voluntary approach can produce significant environmental improvements by lowering emissions of mostly unregulated pollutants, it is far less effective than mandatory regulations in inducing firms to invest in environmental research that leads to the development of cleaner production technologies.

The research team received a grant from the U.S. EPA to organize a workshop at The Ohio State University in 2012 to provide a forum for businesses, the Ohio EPA, and researchers in environmental policy-related disciplines to assess current knowledge and debate the effects and effectiveness of voluntary pollution reduction programs, with a particular focus on firm competitiveness.

There is a lack of research exploring the effects of voluntary pollution prevention practices on a business's ability to develop new environmental technologies.

Abdoul G. Sam



# Combating soybean disease with natural chemicals

Madge Graham, Plant Pathology

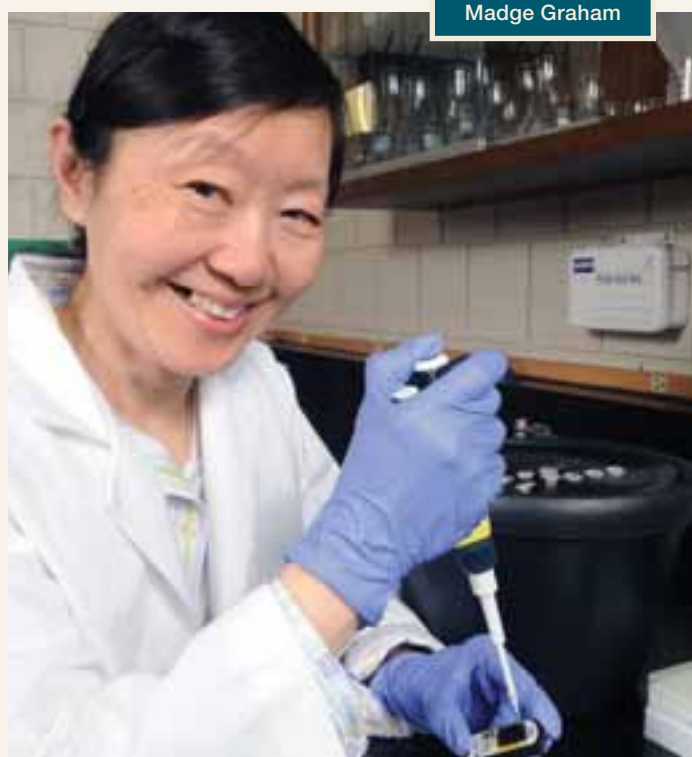
Soybean is the second most important crop for Ohio's economy. Its new role as a material in biodiesel and other bioproduct applications has further boosted its original uses in feed, oil, and food additives. However, despite many years of breeding efforts, pest damage still contributes to a large portion of annual crop loss. One possible solution is to induce a plant's own innate defense mechanisms with chemicals.

Despite many years of breeding efforts, pest damage still contributes to a large portion of annual soybean crop loss.

The herbicide lactofen has been identified by the team's previous work as a chemical that can activate latent defense responses in soybean, and it works to provide resistance in the field. This project explored the effectiveness, induced gene expression, and metabolite changes of two naturally occurring, more environmentally friendly chemicals, fumonisin and juglone, in protecting soybean from pest damage. Biologically, these two chemicals impart similar effects as lactofen in soybean.

In searching for natural chemicals with soybean disease protection properties, the research team found that both fumonisin (from the fungus *Fusarium*) and juglone (from black walnut trees) cause a localized cell death. They also reduce soybean infection from *Phytophthora sojae*, a microorganism that rots soybean stems and roots, in laboratory disease analyses.

From global analyses, the project found that fumonisin and juglone induce novel genes and metabolites. While many of these gene expressions are unique to the respective chemical, some are shared. As the research team narrowed down the induced genes to the shared ones, they found a cell death-related gene and a gene for a specific transcription factor (a type of gene that regulates the expression of other genes). Interestingly, both chemicals also induce both known and previously unreported metabolites, including a series of prenylated isoflavones, which coincides with the



Madge Graham

onset of the cell death program and thus can be considered potential chemical biomarkers. Furthermore, these very specific genes and metabolites give clues to the underlying mechanisms between cell death and disease resistance. This information, in turn, can be utilized to aid in the search of other natural chemicals with similar activities.

This project showed that like the herbicide lactofen, natural chemicals such as fumonisin and juglone can act as plant defense-activators. The common thread is triggering the initiation of a local cell death program, which in turn stimulates the host's own multi-pronged defense responses. Fumonisin and juglone are of totally different classes of chemistry from one another and have different targets in plants. This study paves the way for the development of other potential natural chemicals that protect plants from diseases. In addition, some novel genes uncovered from these studies can serve as excellent candidates for genetic engineering, or they can be targets of traditional breeding and selections for crops with elevated disease resistance.

## Establishing guidelines for humane treatment of diseased dairy cows

Joe Hogan, Animal Sciences

Naomi Botheras, Animal Sciences

Bovine mastitis, a bacterial infection that causes an inflammatory reaction in udder tissue, is the most costly disease in U.S. animal agriculture. It accounts for \$2 billion annually in lost production, veterinary care, and reduced quality and quantity of value-added dairy products in the global market. Mastitis is the most prevalent disease in dairy cows, and therefore the welfare of many cows may be at risk due to pain associated with this disease.

Consumers are demanding to know that food animals are treated humanely, and preventing and alleviating pain are important factors in the ethical treatment and care of animals. However, dairy cows often receive no, or inadequate, pain control in the treatment of a range of tissue injuries and systemic illnesses. Treatment of bovine mastitis traditionally has been confined to antimicrobial products. Furthermore, treating pain in dairy cows may have economic benefits for producers, as animals that are free of pain will likely have enhanced performance and productivity. Establishing dairy practices that are both humane and profitable requires empirical trials that assess behavioral changes associated with mastitis and the efficacy of painkillers as mediators of discomfort.

Collaboration between scientists at OARDC, OSU Extension, and the Animal Welfare Science Centre in Australia led to the design and completion of benchmark trials to correlate dairy cow behavioral responses with clinical signs of mastitis. The research team used technological advances such as remote image capturing surveillance, as well as traditional physiological measurements of inflammation, to evaluate associations between the cows' behavior and their response to mammary irritation. Painkillers administered to cows infected with mastitis reduced systemic physiological signs of disease. These physical responses to painkillers were associated with positive behavioral activities, including increases in



Joe Hogan

Mastitis is the most prevalent disease in dairy cows, and therefore the welfare of many cows may be at risk due to pain associated with this disease.

feed intake, time resting, and frequency of meals compared with cows with mastitis receiving no painkillers.

This project's findings could help agencies such as the World Organization for Animal Health and the International Dairy Federation develop guidelines for a more humane and pragmatic approach to managing pain and discomfort in dairy cows, which has the potential to benefit both the dairy industry and consumers demanding ethical treatment of food-producing animals. Pain relief in cows with mammary disease will enhance their productivity and welfare, yielding an economic benefit for dairy producers.



# Tracing human gastrointestinal disease to its source

Jeffrey T. LeJeune, Food Animal Health Research Program  
Kurt Stevenson, Internal Medicine

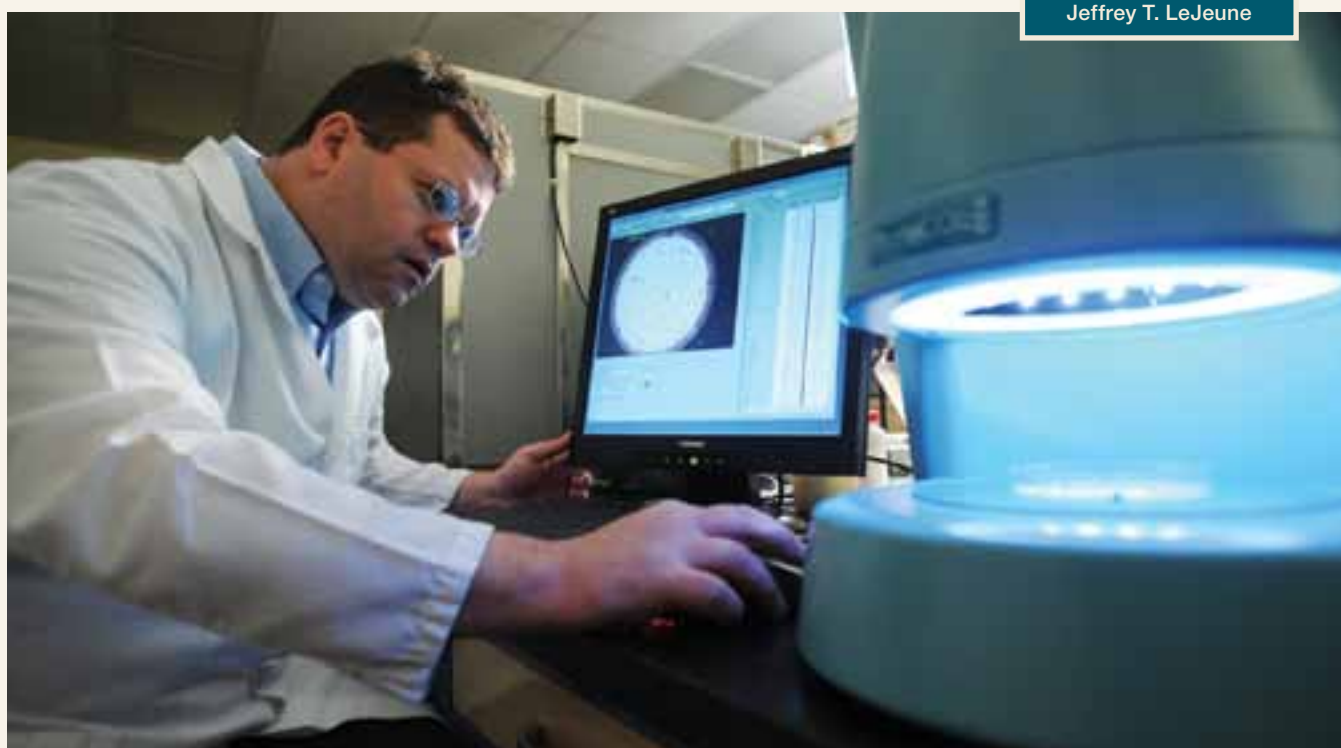
In the past, the bacterium *Clostridium difficile* caused severe gastrointestinal disease almost exclusively among hospitalized patients who had received antibiotic treatment. However, over the last few years, the disease has been increasing in frequency and severity, affecting healthy individuals in the community with no existing risk factors. Because of the change in the disease's epidemiology, Ohio began requiring mandatory reporting of this infection in 2006. The emerging disease is caused by a single strain (clone) of the bacterium that has mutated to produce 20 times more toxin than before. This hypervirulent clone is spreading worldwide, putting many more people at risk for infection.

The recent identification of the hypervirulent *C. difficile* strain in young livestock and retail meat raises concerns that food-producing animals may be reservoirs for this

organism. The research team investigated this question by using molecular epidemiological methods to compare isolates obtained from a variety of animals throughout the United States.

Through several studies, the project documented the presence of *C. difficile* in cattle at the time of harvest, as well as in retail vegetables. The epidemic strains of *C. difficile* were present in the cattle's intestinal content in four regions of the United States, but the data indicated that food animals in general carry *C. difficile* at a low rate at the time they enter the food chain, making it unlikely to cause infection in humans. Additional sources of meat contamination, such as during meat processing, should be investigated as possible points of entry of this organism into the food chain.

The emerging disease is caused by a single strain (clone) of the bacterium that has mutated to produce 20 times more toxin than before.



Jeffrey T. LeJeune

## Enhancing power generation of microbial fuel cells with nanoscale electrode technologies

Lingying Zhao, Food, Agricultural and Biological Engineering

Ann D. Christy, Food, Agricultural and Biological Engineering

Energy demand is increasing globally and locally, while concerns over the economic and environmental costs of continuing to use conventional fossil fuels have prompted a growing interest in renewable energy sources. Converting biomass to energy is an attractive option because cellulosic biomass, including agricultural products and solid wastes, is one of the most abundant renewable sources of energy on earth.

The microbial fuel cell (MFC) is an emerging technology that can convert a wide range of biomass directly into useful energy in the form of bioelectricity. MFCs do not require the intermediate steps of conversion to fuel and combustion of that fuel, thus avoiding large losses in the energy conversion processes. They are environmentally clean, quiet, and highly efficient devices. However, their low power density output currently limits broad application of the technology.

Prior research had identified that the surface area of MFC electrodes is an important factor affecting electricity generation. Therefore, the OARDC research team explored the use of micro- and nanoscale structures on the electrode to enlarge their surface area without increasing the overall size of the MFC device itself, potentially raising electricity output and enabling microbial fuel cells to power a wider range of practical applications.

The project aimed to develop MFCs with nanostructure electrodes, test and characterize them, and evaluate the power output and overall performance of these MFCs in comparison with MFCs with conventional graphite bar electrodes.

The two-year study reached the following conclusions: (1) increasing electrode surface area using microscale graphite powder improved MFC power production; (2) using microscale-activated carbon and nanoscale carbon nanotube powder did not significantly increase MFC power production due to problems with high internal



Ann D. Christy (left) and Lingying Zhao

Cellulosic biomass, including agricultural products and solid wastes, is one of the most abundant renewable sources of energy on earth.

resistances; and (3) nanostructure electrodes made with stainless steel mesh by flame synthesis could significantly reduce the cost and internal resistance of enhanced-surface-area MFCs, thus increasing the feasibility of using nanoelectrodes with this technology.

Future efforts will focus on seeking funding for interdisciplinary projects to develop nanostructure electrodes for MFCs, including flame synthesis methods, as well as examine how running the fuel cells in a continuous flow mode would provide better stability and greater power production. Another ongoing effort is studying the role of different external electric circuits, their effect on the micro-organisms within the microbial fuel cells, and their potential to enhance MFC voltage output.

# Assessing the success of anaerobic digesters in Ohio's climate

Jay F. Martin, Food, Agricultural and Biological Engineering  
Frederick C. Michel, Food, Agricultural and Biological Engineering

Millions of small-scale anaerobic digesters are used by organic waste producers in tropical settings to generate renewable energy and treat wastewater. However, in temperate climates like the United States, commercial anaerobic digestion systems are highly mechanized and costly. As a result, more than 40,000 small and mid-sized farms and countless industries in the United States cannot benefit from this technology, which has great potential to generate energy using on-farm wastes, leading to cost savings.

While laboratory experiments have demonstrated the potential of small-scale and affordable digesters in temperate regions, there is a lack of knowledge about the performance, design, and management of these digesters. Important gaps concern changes that occur in the digesters during cold weather and which management practices may be used to combat the impacts of lower temperatures. Without this information, implementing affordable digesters for smaller-scale waste producers cannot proceed, and benefits remain unrealized.

This project tracked the performance and internal changes within a variable temperature digester over one year in Ohio's temperate climate. A modified fixed-dome digester, the most successful and most common type of small-scale digester, was installed at the Waterman Agricultural and Natural Resources Laboratory in Columbus. The digester used manure from the on-site dairy farm as a feedstock. Since October 2009, the digester has successfully produced methane during warm temperatures. A maximum rate of over 1000 liters of biogas per day was produced in the summer of 2010.

Along the way, the research team identified limitations and design recommendations, including the difficulty of maintaining an anaerobic seal and the importance of insulation. The high level of groundwater at the research site was also problematic. Insulating and burying the digester successfully increased its temperature. However, the lack of insulation on the displacement tank likely resulted in digester temperatures that were lower than

expected. Future designs should include insulation of the digester and the loading and displacement tanks.

This technology has great potential to generate energy using on-farm wastes, leading to cost savings.

The digester's performance, especially biogas and methane production, was clearly correlated with changes in temperature. The greatest production and the greatest methane concentration occurred between July 2010 and November 2010, when the digester was above 20°C. Digester temperatures below 20°C resulted in unstable performance, and the amount of biogas produced under these temperatures is not sufficient to permit year-round use by farmers, pointing to the need for further improvements.

This study was a first attempt to adapt a fixed-dome digester to meet the demand for small-scale digesters in small and medium-size dairy farms in the United States. The temperature and organic loading rate are the key variables to be controlled. Further research and design in these areas should aid the search for simple and low-cost alternatives to produce energy with small-scale digesters in temperate climates.



Jay F. Martin



## Improving soybean disease resistance by identifying its antibiotic properties

Terrence Graham, Plant Pathology

Soybean diseases remain the largest constraint to soybean production, causing millions of dollars in losses in Ohio each year. Natural plant resistance is genetically determined and can be enhanced by introducing new soybean lines through breeding efforts or genetic engineering. Past research has shown that plant metabolites that function as antibiotics against pathogens constitute the major form of soybean resistance. These antibiotic metabolites, called phytoalexins, are induced in a soybean plant when it recognizes elicitors — components of the pathogen's cell wall.

Certain chemicals can mimic the effects of pathogen elicitors and fool the plant into thinking it is under pathogen attack. These chemicals induce very effective disease resistance to a wide range of pathogens. This project used natural pathogen elicitors and a series of chemical mimics to induce soybean disease resistance. Using a technique called liquid chromatography-mass spectrometry (LC-MS), the research team was able to study for the first time the full range of metabolites induced by these elicitors and chemicals.

Past research has shown that plant metabolites that function as antibiotics against pathogens constitute the major form of soybean resistance.

The LC-MS, coupled with unique software developed by the team, was successful in identifying all newly induced soybean metabolites. Both the natural and chemical elicitors generally induced the same metabolites. The team used a series of advanced chemical techniques to discover several classes of soybean metabolites and two metabolites unknown in any plant species. Overall, 28 metabolites were identified, including about 10 never before reported in soybean, yielding new information for soybean's food uses and its medical and health benefits.

The team then analyzed 13 of the new metabolites to test their antibiotic potential against several soybean



Terrence Graham

pathogens, leading to the discovery of a new soybean antibiotic metabolite. Its antibiotic activity was over tenfold that of the previously known antibiotic metabolite. It could be a major player in soybean disease resistance and a key to future breeding for soybean resistance.

The research team's next step is to identify the gene(s) responsible for the formation of the newly identified metabolite. Among these genes should be a key enzyme, and once the gene for this enzyme has been identified, it will be possible to determine its presence in existing soybean germplasm and enhance its role in defending soybeans from a pathogen attack.

# Preventing crop loss by understanding the chromosomes that produce fungus toxins

Thomas Mitchell, Plant Pathology

Fungi are the number one source of food crop disease worldwide and cost Ohio farmers millions of dollars due to diseased plants and fungicide sprays. There are thousands of fungi that can cause disease, but one of the more prevalent and devastating group of fungi are those in the genus *Alternaria* sp. This genus alone has over 5,000 different plant host associations, some of which can destroy an entire field or orchard in a single season. Some of these *Alternaria* species have evolved a unique way to destroy their host tissues — they produce potent toxins that are specific to their host.

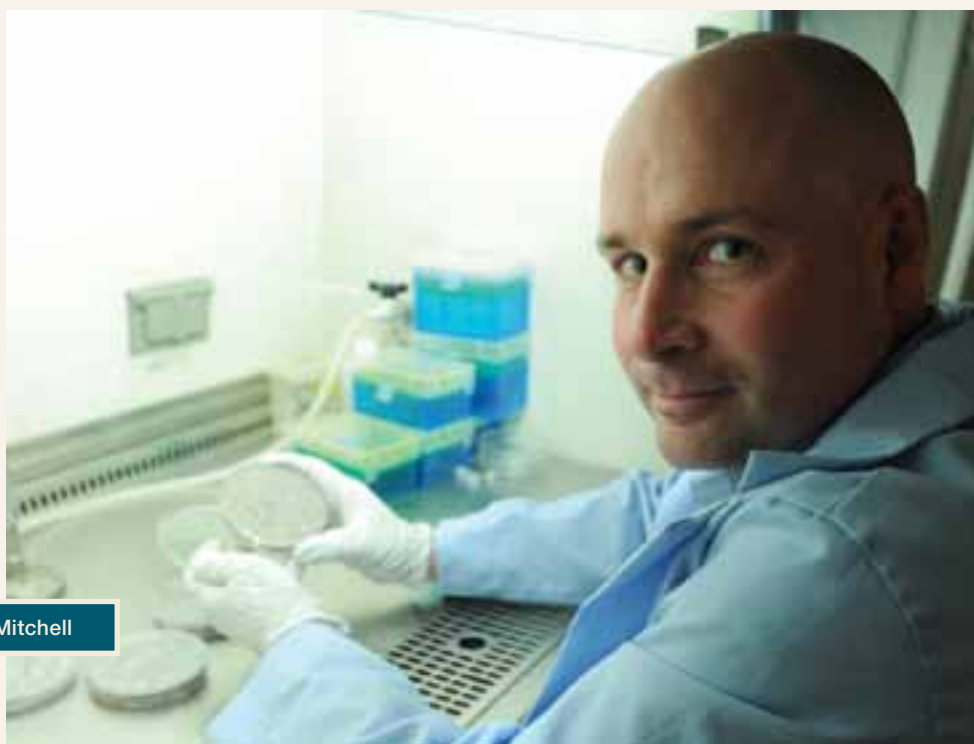
The genes that code for the production of host-specific toxins in the *Alternarias* are carried on extra chromosomes known as conditionally dispensable chromosomes (CDC). Thus, the fungus can lose the chromosome but still survive on regular dead organic matter like other fungi; it is now simply unable to infect its normal host plant. CDCs are generally smaller than the rest of the chromosomes the fungus needs for life, and they are necessary for the fungus to be a plant pathogen. This project was designed to answer

what is unknown about CDCs — their genome sequence, what the genes on them are, and from where they evolved.

The research team first obtained DNA from the entire genome of the *Alternaria* species that infects tomato, *Alternaria arborescens*. This fungus was chosen because its CDC is better described than many of the others, making it a useful starting point. The team then used a novel approach to determine which sequences were from the CDC and which were from the rest of the chromosomes. The novel technique proved to be successful.

The outcome is a genomic sequence of the CDC, identification of many unique and interesting genes, and the beginnings of an understanding of the evolutionary history of this chromosome. The results suggest that much of the chromosome parts were acquired from other fungi in the environment. This project forms the basis of subsequent research that will analyze additional CDCs in other *Alternaria* species, which could eventually lead to finding ways to undermine the effectiveness of the fungus toxins.

There are thousands of fungi that can cause disease, but one of the more prevalent and devastating group of fungi are those in the genus *Alternaria* sp.



Thomas Mitchell

## Analyzing the impacts of varying precipitation on agricultural production

Kristin Mercer, Horticulture and Crop Science

Successful agriculture production relies on many factors, including temperature, precipitation, carbon dioxide (CO<sub>2</sub>) levels, and amount of sunlight. Global climate change will alter these factors and thus affect the growth of crops and agricultural weeds. Monoecious crops, which have separate male and female flowers on the same plant, may be vulnerable to such changes because flowering synchrony between males and females is essential for good pollination and fruit or seed production. It is important to understand how the flowering timing and synchrony of these crops, and thus crop productivity, will be affected by climate change. In addition, the amount of genetic diversity within each crop variety could also play a role.

This project investigated how two monoecious crops that are economically important in Ohio — corn and zucchini — will be affected by changes in precipitation levels, and if genetic diversity plays a role in these responses. The second part of this study focuses on the evolutionary potential of a common agricultural weed in Ohio, velvetleaf, under varying water availability. Under climate change, weeds might evolve to better adapt to the new environment, and the direction and speed of evolution will have important implications for agriculture practice.

In this two-year study, the project team manipulated precipitation levels and monitored plant growth and reproduction. Rain-exclusion shelters were used to reduce moisture in some plots, while other plots were irrigated. Two types of control plots were also used. For corn and zucchini, two varieties with different levels of genetic diversity were planted for each. The timing of flowering, amount of flowers, and production of these crops were monitored to determine if flowering behavior and production varied in different environments.

The team planted the agricultural weed velvetleaf under the same set of water treatments. The performance of the plants, including height, number of leaves, timing of flowering, and seed set was monitored throughout the

Kristin Mercer



A shift in precipitation patterns could affect the flowering and reproduction of certain monoecious crops

season. These data will be used to determine if plants with certain traits, such as faster growth, are likely to produce more offspring under certain water treatment, and therefore have an evolutionary advantage in this altered environment.

The project produced evidence that changes in precipitation patterns could affect sex allocation in zucchini. Under drier or wetter conditions, the low-diversity zucchini variety shifted towards a higher male vs. female sex ratio. In addition, there was greater flower synchrony for the variety with high genetic diversity, likely buffering the effects of environmental change on mating success. For corn, there was no significant effect of water availability on flowering behavior or reproduction. The velvetleaf data are still under analysis.

This study shows that a shift in precipitation patterns could affect the flowering and reproduction of certain monoecious crops and that genetic diversity may play a role in ensuring mate availability. However, elevated temperatures and CO<sub>2</sub> levels are also expected under climate change, and it is unclear how the crops will respond to the combination of environmental shifts. Future work could focus on studying the evolutionary responses of weeds to two or more environmental factors at the same time.



# Identifying genes that allow bacteria to suppress pathogens

Brian B. McSpadden Gardener, Plant Pathology

Plant-associated bacteria are a rich source of genes and metabolites, including those that can be commercially developed as biopesticides and/or pharmaceuticals. Some of these bacteria suppress diseases by producing antibiotics that inhibit pathogen growth and/or enhance resistance in their plant hosts. The bacteria can serve as the basis for biopesticides and thus fill a need in agriculture to replace certain chemical pesticides with safe and effective alternatives.

Bacteria can serve as the basis for biopesticides and thus fill a need in agriculture to replace certain chemical pesticides with safe and effective alternatives.

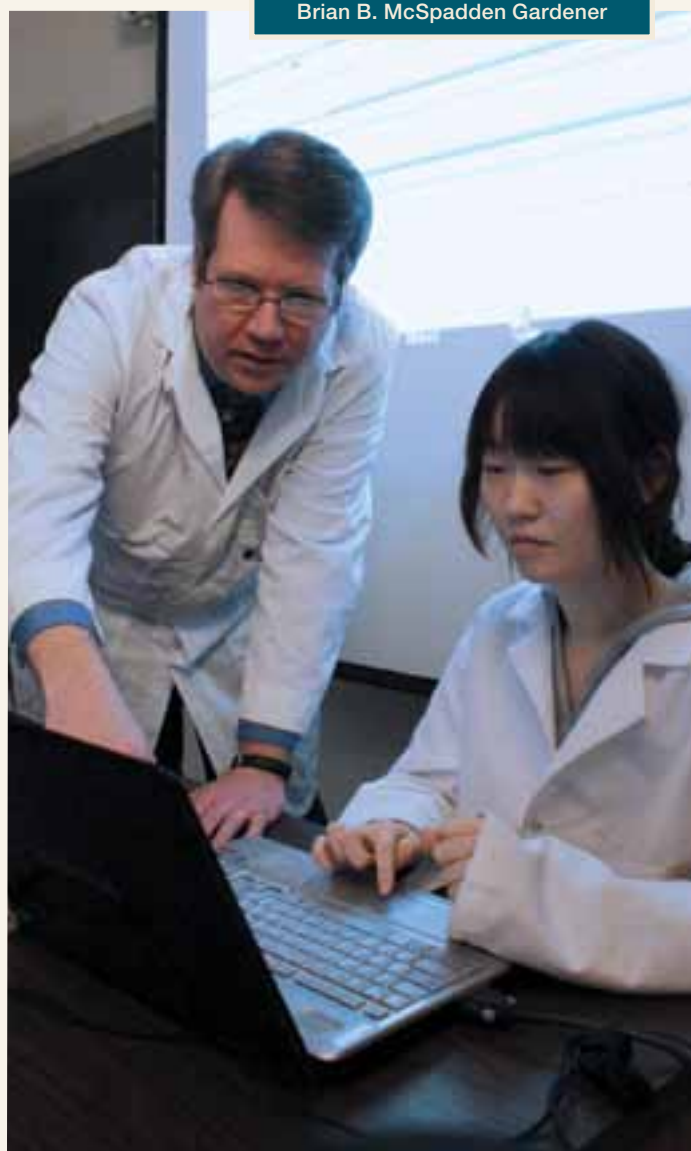
This project aimed to understand the genomic and metabolic components responsible for plant pathogen suppression in different bacterial strains that have substantial biological pest control (biocontrol) and plant growth-promoting activities. To better characterize the bacterial genes involved in plant health promotion, the research team evaluated different computational methods to identify novel genes, and then created mutant strains to study in the lab to identify genes involved in pathogen inhibition and plant health promotion.

The bacterial strains had been previously shown to effectively enhance yields in different crops. Wild-type strains induce plant host resistance in tomato and pepper to both bacterial and a fungal disease. The team is now comparing mutant to wild-type strains to identify mutants deficient in biocontrol and plant growth-promotion activities. Those mutants will then be analyzed to determine which genes were disrupted, indicating the molecules important for pathogen suppression.

The team also used the genome sequences to identify potentially novel genes and clusters of genes that might be co-regulated with genes that are known to be

important for biocontrol. In addition, the team determined the genomes of the several other bacterial species and identified the genes for their active metabolites. Future work will focus on cloning and complementing these novel genes to further study their functions and the metabolites that they produce. This work could eventually reveal new compounds with biopesticide and possibly pharmaceutical potential as antifungal agents. More broadly, the work could also lead to a greater understanding of the components of how bacteria affect the health of their plant hosts.

Brian B. McSpadden Gardener



## Understanding pig immune responses to porcine reproductive and respiratory syndrome virus

Renukaradhya Gourapura, Food Animal Health Research Program

Since the 1990s, porcine reproductive and respiratory syndrome (PRRS) has caused uncontrollable and persistent respiratory viral disease in pigs. PRRS leads to an annual estimated loss of \$664 million to the U.S. economy, but currently available vaccines have failed to completely control the disease outbreak. PRRS gains bodily entry through respiratory mucosal surfaces. Greater than 80 percent of body immune cells are localized at mucosal sites, and scientists have established that generating a protective mucosal immunity can be effective against pathogens such as PRRS. Developing a successful PRRS vaccine requires a thorough understanding of the virus-induced mucosal immune responses in the pig respiratory tract.

To accomplish this, the research team performed a detailed mucosal immune response study in pigs experimentally infected with PRRS. The results showed that the PRRS virus quickly suppresses the Natural Killer (NK) cell function. NK cells typically provide rapid responses to virally infected cells and are unique because they have the ability to recognize stressed cells in the absence of antibodies. This suppression was observed as early as day two and persisted over one month after infection. Agents known to enhance NK cell function also failed and were unable to stop the NK cell suppression in PRRS-infected pigs. In addition to delayed onset of adaptive immunity, there was a rapid increase in the frequency of cell-signaling protein molecules that repress the immune system, as well as white blood cells that suppress immune defense cells.

This project discovered important new information related to how the PRRS virus infects pigs, such as very early onset and prolonged suppression of the immune system. This knowledge will help the research team and others



Renukaradhya Gourapura

design strategies to overcome the suppressive immune response by combining PRRS vaccines with suitable adjuvants. The combination of the vaccine with a potent adjuvant will boost the immune response of the vaccine, in addition to limiting and/or eliminating the virus-induced immune suppression. One of the adjuvants used by the project team in conjunction with a PRRS vaccine overcame the immunosuppressive response and also protected pigs against genetically variant PRRS viral challenges. The results of this study will ultimately help scientists develop improved PRRS vaccines, thus eventually reducing the economic burden caused by the virus both in Ohio and throughout the United States.

Greater than 80 percent of body immune cells are localized at mucosal sites, and scientists have established that generating a protective mucosal immunity can be effective against pathogens such as PRRS.

# Understanding the survival and persistence of the *C. jejuni* bacterium in food animals and their environments

Gireesh Rajashekara, Food Animal Health Research Program

Gastroenteritis caused by the *Campylobacter jejuni* bacterium is the most common form of bacterial food poisoning in the United States and worldwide, accounting for up to \$6 billion in losses annually. Chickens are the primary source of human infections. Despite progress in recent years, scientists' understanding of the pathogenic mechanisms of *C. jejuni* lags behind that of other foodborne pathogens such as *Salmonella* and *E. coli*. In seeking to understand how *C. jejuni* is able to inflict such damage, the research team hypothesized that a twin-arginine translocation (TAT) pathway is a key reason.

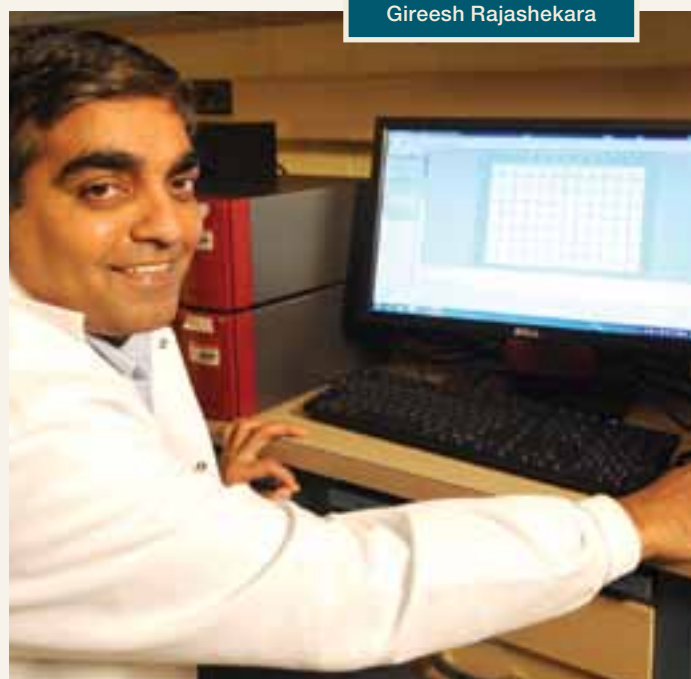
The TAT pathway is a protein-secretion pathway found in bacteria that secretes partially or fully folded proteins across the cytoplasmic membrane of bacteria. The TAT pathway represents an important virulence mechanism in many bacterial pathogens and also contributes to the bacterial stress response leading to the survival of pathogenic bacteria in the environment or the host. The research team's hypothesis was that proteins secreted by the TAT system are important for the success of the *C. jejuni* pathogen because they reinforce the assembly and surface structures necessary for *C. jejuni*-host interactions as well as stress responses that enable the survival of *C. jejuni* inside and outside an animal host.

The project's goal was to identify and define the importance of TAT-exported proteins to *C. jejuni* survival and persistence and to evaluate antibacterials, alternative to conventional antibiotics, as a potential pre- and post-harvest food safety control strategy.

Scientists' understanding of the pathogenic mechanisms of *C. jejuni* lags behind that of other foodborne pathogens such as *Salmonella* and *E. coli*.

The project's results showed that TAT-exported respiratory proteins contribute in different ways to key *C. jejuni* traits, depending on the environment's temperature and/or oxygen content. Consequently, these proteins partially bestow *C. jejuni* with its remarkable ability to adapt and survive in a variety of niches, a characteristic that is crucial for understanding this bacterium's prevalence, persistence, and success as a pathogen.

Furthermore, researchers determined that the TAT-exported protein Mfr contributes to *C. jejuni*'s oxidative stress responses. In addition, the TAT-exported alkaline phosphatase PhoX and phosphate utilization are critical to *C. jejuni* physiology and survival, as they are in other bacteria. This combination of TAT-exported proteins and their characteristics seem to be significant factors in contributing to *C. jejuni* survival and persistence. Finally, high throughput screening identified approximately 500 small molecules — alternatives to antibiotics — that are effective against *C. jejuni*. These compounds are being evaluated for potential commercial use.





## Using plant hormone technology to enhance soybean biomass under environmental stresses

Jyan-Chyun Jang, Horticulture and Crop Science  
John J. Finer, Horticulture and Crop Science

Plant hormones are chemical compounds essential for growth, development, and environmental responses. Synthetic analogues of many plant hormones are widely used in agriculture and horticulture for a number of applications, including fertilizers. However, their costs can be high, residues can be problematic, and many of them are prohibitively expensive. Peptide hormones are small fragments of secreted proteins that are the most abundant hormones in mammals. While human peptide hormones have been used for therapeutic and health purposes, they have only recently been found in plants and have tremendous potential for new applications.

The research team recently discovered that modifying the levels of two plant peptide hormones (GASA4 and GASA6) can enhance growth and increase the lifespan of genetically modified plants. This raises the possibility of using peptide hormone technology for enhancing plant biomass production, particularly from soybeans, and bioenergy production under environmental stresses. This project tested if GASAs can be used as new tools for crop improvement, with the aim of benefiting agriculture in Ohio and beyond.

Using *Arabidopsis thaliana* (a small flowering plant) as a model, the team dissected the protein structure of molecules to determine the region that is important for protein function. After identifying a region critical for GASA hormone secretion, the team created different mutants that either underexpressed or overexpressed GASA4 and GASA6. While the underexpressed plants show only

Peptide hormones are small fragments of secreted proteins that are the most abundant hormones in mammals.



Jyan-Chyun Jang

subtle changes, the overexpressed plants display visible characteristics in growth and development. Overexpression of GASA4 led to higher biomass and late flowering, whereas overexpression of GASA6 resulted in smaller plants and early flowering. This is consistent with the hypothesis that GASAs can exert hormonal effects and alter the patterns of plant growth and development.

To determine if GASA peptide hormones can be used for crop improvement, the team attempted to generate genetically modified, or transgenic, soybean plants that overexpress *Arabidopsis* GASA4 and GASA6. Seven transgenic GASA4 events were obtained — i.e. DNA recombination in the plant cells. For unknown reasons, no transgenic events were recovered from GASA6. Researchers also isolated four native soybean GASA genes and made individual transformation constructs, i.e. genetically altered cell genomes. Work is in progress to deliver these overexpression constructs into soybean tissue and create stable transgenic plants that could be used to enhance biomass production. Together, these results suggest that GASA genes are potential new tools for crop improvement.

While much of the results support the team's hypotheses, a few questions remain unanswered. Future work will continue to characterize the soybean GASA4 transgenic plants to determine their success in biomass production and stress tolerance. Because neither GASA4 nor GASA6 secreted efficiently into the cells, work is in progress to find a different strategy to monitor the hormones' trafficking patterns in cells.

# Developing a promising vaccine candidate for porcine reproductive and respiratory syndrome

Jianrong Li, Food Science and Technology

Porcine reproductive and respiratory syndrome (PRRS), caused by a virus (PRRSV), is considered the most economically devastating viral disease in global agriculture. It is estimated that annual losses associated with PRRS amount to half a billion dollars in the United States. Two genotypes of PRRSV, European (type 1) and North American (type 2), have been identified. Commercial PRRSV vaccines are currently available but do not effectively protect against multiple PRRSV strains.

A successful vaccine has several components. First, the vaccine should be safe for pigs; second, the vaccine should trigger strong immunities; and finally, the vaccine should cross-protect against both types of PRRS. The project team used vesicular stomatitis virus (VSV) as the vector, or means, to deliver the PRRS vaccine. VSV is commonly used as a vector because it can deliver a broad range of viral genes into cells or animals. The VSV vector is particularly attractive for developing vaccines against three types of viral pathogens: viruses that cause persistent infection such as HIV; that are highly infectious such as Ebola; and that cannot be grown in cell culture such as human norovirus. Recently, VSV vectored HIV entered phase I in human clinical trials. The team aims to develop VSV as a vehicle to induce proteins that trigger defensive immune responses against PRRSV.

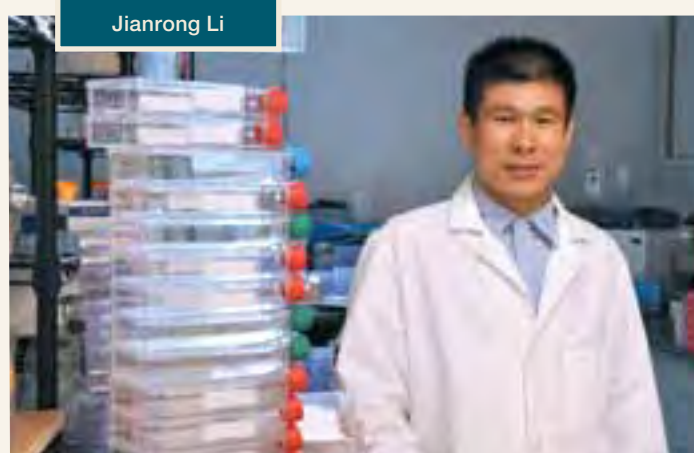
The team went through several steps in its search for an effective PRRS vaccine. They first tried to show that live attenuated VSV would be an excellent vaccine vector for PRRS. Researchers developed a genetically engineered (recombinant) methyltransferase (MTase)-defective VSV as the vaccine vector. The VSV's messenger RNA possesses a cap structure that is essential for viral replication and gene expression. MTase is an enzyme

that methylates the cap structure. Wild-type VSV caused death and weight losses in animal models, but MTase-defective VSV lost virulence in animals. These data suggest that MTase-defective VSV is a safe vaccine vector.

The team then engineered and characterized an MTase-defective VSV expressing PRRSV protective antigens. To enhance the PRRSV vaccine, the team also cloned porcine heat shock gene (HSP70) into the VSV vector. HSP70 can enhance both innate and adaptive immune responses. All the engineered viruses grew slower than wild-type virus in baby hamster kidney cells. The results showed that a selection of engineered VSV expressing PRRSV antigens was successfully recovered; these viruses reproduced slowly in cell culture; and PRRSV antigens and the porcine heat shock protein were expressed by the VSV vector.

Researchers also aimed to determine if VSV's expression of a single PRRSV antigen was sufficient to induce specific immune responses against PRRSV. Recombinant viruses expressing single PRRSV antigens were inoculated into animals, and the team found that they triggered only a low level of T cell response, which is not sufficient against PRRSV infection. Thus, the final step was to enhance immune responses by having VSV express multiple PRRSV antigens. The team found that PRRS-specific antibodies significantly improved when VSV expressed either two or three antigens. Ultimately, VSV expressing two antigens stimulated the strongest immune responses and is a promising vaccine candidate against PRRSV.

It is estimated that annual losses associated with PRRS amount to half a billion dollars in the United States.



## Understanding how pathogen-specific, disease-resistance proteins protect plants

David Mackey, Horticulture and Crop Science

The bacterium *Pseudomonas syringae* (*P. syringae*) causes spot and speck diseases on diverse plants, including soybean, tomato, and other Ohio crops. Bacteria move with the water cycle and exist ubiquitously on plant surfaces, where they live at low population levels without causing disease. Environmental conditions, including temperature and humidity, prompt the bacteria to invade the intracellular space of leaves and fruits where, in a susceptible host, they proliferate to high levels and cause disease symptoms.

Because of their ubiquitous nature, the most desirable way to protect against *P. syringae* is to use resistant plant cultivars. Dominant resistance-, or *R*-genes, are a predominant form of resistance utilized by breeders. *R*-genes encode for proteins that function as surveillance molecules in the plant immune system. When an *R*-protein recognizes an elicitor from a potential pathogen — including insects, nematodes, bacteria, fungi, and viruses — it induces defense responses that render the plant immune. Although the *R*-genes' roles in plant defense are well-known, the molecular mechanisms that activate the *R*-proteins are largely unclear. This project aimed to understand the activation process by studying the model plant *Arabidopsis thaliana* and analyzing the activation of two *R*-proteins — RPM1 and RPS2.

The first goal of this project was to investigate the recognition specificity of RPM1 and RPS2. Previous studies have identified elicitors from *P. syringae* that activate RPM1 and RPS2 by targeting a common plant protein, which regulates both *R*-proteins. Interestingly, the team discovered that both *R*-proteins respond to the elicitors but with inversely related strengths. In other words, an elicitor that strongly activates RPM1 also weakly activates RPS2, and vice versa. As a result, the team shifted from a model in which individual *R*-proteins recognize pathogen effector proteins to a model in which effectors induce disturbances inside plant cells that are

David Mackey



recognized by two or more *R*-proteins, which in turn activate defense responses that vary in strength.

The second goal of the project was to use these elicitors to study how different characteristics of RPM1 and RPS2 account for the observed differences in their recognition specificity and response strength. The results of this study, which is ongoing, will reveal which characteristic(s) of RPM1 and RPS2 mediate recognition of their elicitors. Knowledge gained from this work will be directly applicable to *R*-proteins from agronomically important plants. Furthermore, it will be relevant to related proteins that are key players in animal innate immune systems, leading to a greater understanding of how to defend against pathogens.

Environmental conditions prompt the bacteria to invade the intracellular space of leaves and fruits where they proliferate to high levels and cause disease symptoms.



# Understanding native lady beetle decline in Ohio landscapes

Mary Gardiner, Entomology

Lady beetles are important predators of agricultural pests, providing a key ecosystem service to farmers and gardeners. In recent decades, dramatic declines in multiple native lady beetle species have occurred across the north central United States. One hypothesis to explain this is that non-native lady beetles are consuming the eggs of native species, leading to a reduction in their abundance. This project was the first to conduct a large-scale test of this hypothesis in the field by measuring rates of native and non-native lady beetle egg predation within common foraging habitats and determining the organisms responsible.

Researchers found that all lady beetle species suffered egg predation in foraging habitats ranging from grasslands to corn and soybean fields. However, the eggs of native species were consumed more frequently by predators compared to common non-native species. These data indicate that greater egg predation of native lady beetles may be contributing to their decline.

As previous laboratory studies had focused on the role of non-native lady beetles as egg predators, the research

In recent decades, dramatic declines in multiple native lady beetle species have occurred across the north central United States.

team expected to find that these species were the dominant predators of native and non-native eggs. However, the team found no incidences of non-native lady beetles acting as egg predators. Instead, a diverse community was responsible for native lady beetle egg predation, particularly harvestmen or “daddy long legs,” grasshoppers, and slugs. Prior to this study, their predation of lady beetle eggs and their potential role in the decline in native lady beetles was not known. In addition, the complexity of the predator group attacking lady beetle egg masses was found to be much greater in grassland habitats, which are often thought of as a refuge for lady beetles.

In addition to its research goals, the project established the Buckeye Lady Beetle Blitz (BLBB), a citizen science program to monitor lady beetle populations across Ohio. Participants attended annual workshops across the state where they were provided with training to identify lady beetles and other beneficial insects and received a toolkit for collecting lady beetle data. Over 450 participants have collected data on the abundance of lady beetles from their backyard garden as part of this project to date. These volunteers provide critical data used to track populations of lady beetles throughout the state. The BLBB project is ongoing, and more details are available on the project website (<http://ladybeetles.osu.edu>).


Future work on lady beetle populations will examine whether egg predation explains the decline of rare native lady beetles. The team will compare rates of egg predation in Ohio with regions where these species remain common, as well as whether other lady beetle species are exhibiting early indications of population decline.

Mary Gardiner



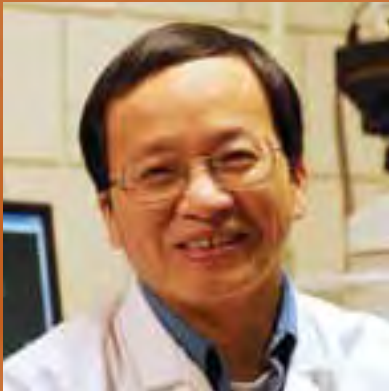
# Student Projects



A person is working in a greenhouse, tending to plants. The background shows a curved structure, possibly a tunnel or a large container, and the overall scene is bathed in a warm, orange-red light.

**The Director's Undergraduate Research Competitive Grant Program and the Graduate Research Competition provides students with a professional grant-writing, research, and reporting experience. Graduate students who receive awards are asked to serve on a panel to review applications in the following year's competition. This experience provides students with the opportunity to develop their skills in grant-writing and reviewing — skills that are essential to their careers.**





---

SEEDS funding played a pivotal role in the successful application for a \$570,000 grant from the National Science Foundation's Integrative Organismal Systems program in 2012. The proposal was rejected in 2009 due to lack of key supporting data, but the SEEDS funding helped the team make significant progress in 2010 and submit a more competitive proposal in 2011.

— *Guo-Liang Wang, Plant Pathology*

---

# Reducing fat accretion in poultry to improve profitability

## UNDERGRADUATE PROJECT

Aishlin Lee, Animal Sciences

Kichoon Lee, Animal Sciences, Advisor

Worldwide poultry consumption has been increasing steadily for many years. At the same time, the ratio of fat to muscle in poultry has increased. This means that poultry feed has been wasted to produce a product that is of lesser economic value, as the muscle is what the farmers sell. Reducing the amount of fat in poultry goes hand in hand with improved feed efficiency, and thus saves the farmer money. Feed is the main input cost of producing meat, and it is getting more and more expensive as the price of corn rises. Reducing the amount of feed that is stored as fat in the birds means greater profitability in producing the birds.

This project aimed to find a nutritional element that could reduce fat accretion in poultry. Identifying such dietary factors has potential economic significance and a potential link to fat accretion in humans as well. Recent studies have shown that an increase in selenium concentration — a mineral that is essential to health but is only required in small amounts — is associated with an increase in the number of fat cells in cell culture. The role of selenium

in fat cell development had not previously been studied in chickens.

The project's first objective was to determine if increased selenium concentration causes an increase in fat cell numbers, as well as an increase in several different fat cell differentiation markers in a cell culture study. The second objective was to determine if an increase in selenium supplementation in poultry feed would be associated with an increase in fat pad weight.

The cell culture study found that as selenium concentration increases, so does the number of fat cells. In addition, greater selenium concentration causes an increase in the number of cells that differentiate between the precursors to fat cells and fat cells. The feed manipulation study found that greater selenium supplementation in feed causes an increase in fat pad weight compared to a control level of supplementation.

This research could improve understanding of how to control specific nutritional elements to help reduce fat accretion in chickens, and thus improve their value to farmers. This data will be used to design further studies on selenium's effect on fat accretion in poultry species. These future studies may include investigations into selenium's effect on cell cycle exit and the effect selenium has on glucose uptake.

Reducing the amount of feed that is stored as fat in the birds means greater profitability in producing the birds.



Aishlin Lee

# Examining the factors behind maize virus transmission by insects

DOCTORAL PROJECT

Yuting Chen, Entomology  
Andrew Michel, Entomology, Advisor

Rhabdoviruses infect humans, livestock, and crops, and plant rhabdoviruses infect both their plant hosts and insects. Maize fine streak virus (MFSV) is transmitted by the black-faced leafhopper, *Graminella nigrifrons*, and has devastated corn crops, but it has not arrived in Ohio yet. *G. nigrifrons* can be separated into three classes: transmitters, which can transmit MFSV to new plant hosts; acquirers, which become infected but cannot transmit MFSV; and non-acquirers, which do not acquire MFSV. Although information on the biological characteristics of *G. nigrifrons* is available, nothing is known about the insect's genome. In addition, the transmission mechanism of MFSV by *G. nigrifrons* is still poorly understood.

This project aimed to better understand the molecular factors required for rhabdovirus transmission by insects and to help prevent MFSV from spreading to Ohio. Moreover, *G. nigrifrons* transmits many other viruses, such as Maize chlorotic dwarf virus (MCDV), which causes significant crop losses in Ohio. The sequencing data provide by this study could help to shed light on the interaction between *G. nigrifrons* and MCDV and contribute to controlling the spread of MCDV in Ohio.

The team first used *G. nigrifrons* transmitters and acquirers to construct two complementary DNA (cDNA) libraries. Researchers found significant down-regulation of three peptidoglycan recognition proteins (PGRP-SB1, SD, and LC) in transmitters as compared to unexposed insects (used as control). However, other genes involved in immune response and RNA interference pathway, such as gram-negative bacteria binding proteins (GNBPs) and Dicer-2 did not show significant difference among transmitters

*G. nigrifrons* transmits many other viruses, such as Maize chlorotic dwarf virus (MCDV), which causes significant crop losses in Ohio.

and control leafhoppers. The down-regulation of PGRPs in MFSV transmitters suggests a possible interaction with rhabdovirus transmission by vectors.

The team will use these new molecular markers to characterize genetic variance among *G. nigrifrons* in Ohio, as well as test for variance among different populations from other states. In addition, *G. nigrifrons*' genomic resources will be used for testing their fitness and mating preferences, which may explain the MFSV transmission constraints from an ecological perspective. Furthermore, researchers will test more gene expression level differences among the three classes of *G. nigrifrons* to explain their defense mechanism against MFSV, as well as the viral transmission mechanism.

Yuting Chen





# Using rain gardens to mitigate the harmful effects of land-use changes

## MASTER'S PROJECT

Derek Schlea, Food, Agricultural and Biological Engineering

Jay Martin, Food, Agricultural and Biological Engineering, Advisor

Land-use changes that alter natural water flow regimes can have harmful consequences for riverine systems. Residential, commercial, and industrial developments transform the landscape by converting surfaces into impervious rooftops, driveways, roads, and parking lots. The result is an increase in the volume of stormwater runoff, higher peak flows, and a shorter time to peak flow after storm events. This can cause flooding, erosion, and higher pollutant loading in streams, rivers, lakes, and estuaries.

Rain gardens — planted depressions that absorb rainwater runoff from impervious urban areas — represent a sustainable and economic method for decreasing the volume of water that flows into rivers and streams during storm events. For developments that were built without permanent stormwater controls, rain gardens may be helpful solutions compared to centralized and more costly alternatives. However, there is a lack of knowledge about the behavior and performance of rain gardens in these urban redesign scenarios.

This project examined the hydrologic performance of terraced, street-side rain gardens installed in an existing development by monitoring inflow and outflow volumes and water tables during storm events and simulated experiments. Researchers addressed relationships between inflow volume and hydrologic performance, and analyzed the behavior of the internal water storage zone and the implications this may have on rain garden design.

The research team estimated rain garden performance during simulated storm events using variables such as runoff volume reduction, peak flow reduction, and peak delay. The rain garden terracing design was effective at facilitating stormwater entry into the gardens, despite



Derek Schlea

limited space availability. For eight simulated storm event experiments, the street-side rain gardens reduced inflow volume by 37 percent. Relationships between rainfall depth and volume reduction were described for rain gardens of different surface area to drainage area ratios. From these relationships it was conservatively predicted that the rain gardens retained the entire runoff volume for 26 percent of the natural storm events monitored.

The results of this study proved that rain gardens can benefit existing developments by reducing runoff volume and peak flow, and provide a dynamic internal water storage zone with the potential to improve water quality. The project's findings also show the importance of understanding interactions with the existing soil, drainage system, and the entire drainage area when designing urban rain gardens. Future studies should be conducted on street-side rain gardens to test hydrologic performance for different soil moisture conditions and to evaluate water quality performance. Economic analyses of rain gardens in urban redesign scenarios should be continuously performed to consider unique design and construction features.

Rain gardens — planted depressions that absorb rainwater runoff from impervious urban areas — represent a sustainable and economic method for decreasing the volume of water that flows into rivers and streams during storm events.

# Strengthening farm income and enhancing human nutrition by altering how crops are grown and valued

DOCTORAL PROJECT

Natalie R. Bumgarner, Horticulture and Crop Science  
Matthew D. Kleinhenz, Horticulture and Crop Science, Advisor

Fresh food crops have two distinct values. There is the income farmers make by selling them, and there is the nutritional value they offer consumers. Clearly, farmers aim to strengthen their business each season, and consumers are increasingly concerned about the nutritional content of their produce. Thus, clarifying the factors that influence income potential and nutritional value in major crops can benefit both groups.

This project set out to discover how growing conditions — i.e. temperature, soil nutrients — affect these values in lettuce. Lettuce was studied because it is the second-most consumed vegetable in the United States, but it ranks 26th among common fruits and vegetables in nutritional value. Therefore, even small increases in key lettuce dietary constituents achieved through improved management may benefit consumers significantly.

A key obstacle is that farmers are typically paid for the amount, rather than the nutritional value, of fresh vegetables they supply. The abundance or weight of crops, but not their nutritional content, tends to be greatest when growing conditions are ideal. The project’s key questions were whether a system can be devised that produces large quantities of nutritionally dense vegetables, as well as whether this system can succeed in the most challenging growing conditions — during fall and winter. Crop production and marketing from fall to spring is increasingly common in northern latitudes such as Ohio. Farmers benefit from the income, and consumers enjoy



Natalie R. Bumgarner

the extended supply of fresh, locally grown, and nutritious vegetables. Unfortunately, cold, dimly lit fall and winter days make vegetable production difficult.

Improved nutrient and temperature management schemes may help lessen this challenge. The research team documented the effects of multiple fertility programs and root- and shoot-zone heating strategies (applied in open field and high tunnel settings in the fall and spring of two years) on many farmer- and consumer-oriented variables, including crop abundance and composition. The team also calculated the nutritional yield of each treatment — the amount of dietary and nutritional components it provided. Tracking nutritional yield can help farmers balance their roles as generators of income and engines of health.

The project yielded several insights on how this balance can be achieved through crop management. As expected, many treatments resulted in few, small leaves with a high nutritional index or many larger leaves with a low nutritional index. However, a few treatments yielded a relatively large leaf mass bearing a moderately high nutritional index. These treatments tended to feature moderate temperature and nutrient levels and above-average light levels. Developing methods with the greatest potential to benefit farmers and consumers will continue. The next step is to explore ways to improve the efficiency and sustainability of these new “high-achieving” systems.


Even small increases in key lettuce dietary constituents achieved through improved management may benefit consumers significantly.





# Publications, Presentations, and Graduate Students





**Sharing knowledge through publications and professional meetings is an important part of research, as is training graduate students for careers in research. Using data from SEEDS projects, OARDC scientists have reported the publication of 807 peer-reviewed articles, bulletins, abstracts, and popular press articles. More than 1,300 presentations have been made in locations throughout the world.**





## Presentations, Posters, Conference Proceedings

**Ara, S., Irwin, E.G., Haab, T.** Measuring the Effects of Lake Erie Water Quality Using Spatial Hedonic Price Models. Federal Reserve Bank of Cleveland Green Recovery Applied Research Seminar. Cleveland, OH. April 8, 2010.

**Bowe, T., Christy, A., Zhao, L.Y., Tuovinen, O.** 2012. Amplification of Microbial Fuel Cells Electric Potential. 2012 American Society of Agricultural and Biological Engineers Annual Meeting.

**Carlson, E.M.** Gastrointestinal Activity of Saponins from Soy and Tomato. Russell Klein Annual Nutrition Symposium. United States. June 2009.

**Castano, J., Martin, J.** Gas Production in Fixed Dome Digesters in Temperate Climates. American Ecological Engineering Society 2011 Conference. Asheville, NC. 2011.

**Chen, Y., Irwin, E.G., Jayaprakash, C.** Ecological Feedbacks and Fast-Slow Dynamics in a Model of Amenity-Driven Regional Growth. American Agricultural Economics Association Meeting. Orlando, FL. June 26, 2008.

**Chen, Y., Irwin, E., Jayapakash, C.** Managing Regional Growth in a Coupled Ecological-Economic Model. North American Regional Science Council Annual Meeting. New York, NY. November 10, 2008.

**De La Torre Cuba, C., Lewandowski, D.J.** 2008. Sequence Comparisons between Hosta virus X Isolates and Differential Infection of Hosta Cultivars. Abstracts of presentations, Annual Meeting of the American Phytopathological Society. 98:S45.

**Drozd, M., Gangaiah, D., Rajashekara, G.** 2010. Small Molecule Inhibitors as Anti-Campylobacter Jejuni Drug Candidates. 61st North Central Avian Disease Conference and Symposium. 61: 11.

**Drozd, M., Gangaiah, D., Rajashekara, G.** 2010. Contribution of PhoA(cj) to Twin Arginine Translocation Mediated Campylobacter jejuni Function and Resilience to Environmental stresses. Annual Meeting of Conference of Research Workers in Animal Diseases. 91: 106.

**Dwivedi, V., Manickam, C., Patterson, R., Dodson, K., and Renukaradhya, G. J.** Steps towards Development of a Novel Mucosal Vaccine to PRRSV. International PRRS Symposium. Chicago, USA. December 5, 2009.

**Dwivedi, V., Manickam, C., Patterson, R., Dodson, K., and Renukaradhya, G.J.** Development of a Novel Mucosal Vaccine to Protect against Porcine Reproductive and Respiratory Syndrome in Pigs. Symposium on Fresh Perspectives: Opportunities for Linking Research and Engagement to Economic Development. College of Food, Agricultural, and Environmental Sciences, ATECH, TCO. Columbus, OH. February 3, 2010.

**Dwivedi, V., Manickam, C., Patterson, R., Dodson, K., Murtaugh, M.P., Torrelles, J., Schlesinger, L., Renukaradhya, G.J.** Mucosal Vaccine to Protect against Porcine Reproductive and Respiratory Syndrome: A New Perspective. 9th International Veterinary Immunology Society (IVIS) meeting. Tokyo, Japan. August 17, 2010.

**Garrett, K.** Exploratory Allelopathic Chemicals as Plant Defense Activators. Denman Undergraduate Poster Competition. Columbus, OH. May 2008.

**Grewal, P.S.** Urban Lawn Care: Biological Diversity and Environmental Responsibility. Michigan Green Industry Trade Show and Convention. Novi, MI. March 2, 2011.

**Grewal, P.S.** Urban Soil Biology and Health. Workshop on Rediscovering the Rhizosphere: Importance of Plant and Soil Interactions to Urban Agriculture and Landscaping. Cleveland, OH. May 24, 2011.

**Grewal, P.S.** Building Effective Organic Lawn Care Programs. Ohio Turfgrass Foundation Conference and Show. Columbus, OH. December 9, 2009.

**Guttieri, M., Sneller, C., Stinner, D.** Organic Hard White Wheat for Ohio. OFFER Field Day. Wooster, OH. September 2, 2010.

**Harms, D.A., Whitehill, J., Smitley, D., Cipollini, D., Koch, J., Mittapalli, O., Bonello, P.** Characterization of Variation and Mechanisms of Resistance of Ash to Emerald Ash Borer. Gordon Research Conference on Plant-Herbivore Interactions. Galveston, TX. February 21–25, 2010.

**Hu, J., Mitchell, T.** Sequence Assembly of the *Alternaria arborescens* CDC. The 26th Fungal Genetics Conference. Pacific Grove, CA. March 2011.

**Hu, J., Mitchell, T.** Sequence Assembly of the *Alternaria arborescens* CDC. The American Phytopathological Society Annual Meeting. Charlotte, NC. August 2011.

**Hu, J., Mitchell, T.** Using Whole Genome Approaches to Understanding the Basis of Fungal Virulence. The 1st International Plant Pathogenomics Conference. Shengzhen, China. January 2011.

**Hu, J., Mitchell, T.** Whole Genome Analysis of Two Fungal Plant Pathogens. The Ohio Plant Biotechnology Consortium. Columbus, OH. November 2010.

**Irwin, E.G., Chen, Y., Jayaprakash, C.** A Dynamic Model of Household Location, Regional Growth and Endogenous Natural Amenities with Cross-Scale Interactions. *Frontiers of Environmental Economics*. Washington, DC. February 24, 2007.

**Issmat, I.K., Wolboldt, M., Yasser, S., Olson, J.W., Rajashekara, G.** 2011. The Role of Respiratory Proteins in *Campylobacter jejuni* Adaptation to Different Temperature and Oxygen Conditions. General Meeting of the American Society for Microbiology, 110th General Meeting. 111: 11.

**Issmat, I.K., Dharanesh, G., Rajashekara, G.** 2010. The Twin Arginine Translocase (TAT) Secretion System is Important for Small Organic Acid Metabolism and Chemotaxis in *Campylobacter jejuni*. American Society for Microbiology, 110th General Meeting. 110: 11.

**Johnson, J.L., Bomser, J.A., Scheerens, J.C., Giusti, M.M.** Effects of Different Black Raspberry Extracts on Colon Cancer Cell Proliferation in an In Vitro Cell System. IFT Annual Meeting and Food Expo. Anaheim, CA. June 6–9, 2009.

**Lee, A., Lee, K.** In Vitro Effects of Selenium Supplementation on Adipose Tissue Growth and Development. NCC210. Washington, DC. April 8, 2011.

**Lewis Ivey, M.L., Miller, S.A.** Management of *Phytophthora capsici* and Potential Human Foodborne Pathogens in Irrigation Water. Muck Crops School. Willard, OH. January 6, 2011.

**Luo, J., Campbell, L.G., Mercer, K.L.** Climate Change may Reduce Fecundity of Monoecious Crops through Altered Investment in Male and Female Flowers. 95th Ecological Society of America Annual Meeting. Pittsburgh, PA. August 4, 2010.

**McSpadden Gardener, B.** Redefining the Paradigm of Biocontrol. Annual Meeting of the American Phytopathological Society. Charlotte, NC. August 9, 2010.

**Ma, Y., Wei, Y., Divers, E., Whelan, S., Li, J.** The Impact of mRNA Cap Methylation Status on the Pathogenesis of Vesicular Stomatitis Virus in Vivo. American Society for Virology. Minneapolis-St. Paul, MN. July 16, 2011.

**Manickam, C., Dwivedi, V., Khatri, M., Patterson, R., Papenfus, T., Renukaradhya, G.J.** Mucosal Adjuvanticity of *M. tuberculosis* Whole Cell Lysate to PRRSV Live Vaccine Leads to a Better Immunostimulation and Protection against PRRSV Challenge. Conference of Research Workers in Animal Diseases. Chicago, IL. December 7, 2010.

**Martin, J.** Developing the Model T of Anaerobic Digesters. Decentralized Waste Treatment Conference – Waste to Energy. Columbus, OH. February 5, 2010.

**Mittapalli, O., Bai, X., Herms, D.A., Bonello, P.** Functional Genomics of an Invasive Insect Pest: Insights at the Tissue Level. Fifth Annual Arthropod Genomics Symposium. Kansas City, MO. June 10–13, 2011.

**Mittapalli, O.** Functional Genomics of the Emerald Ash Borer-Ash Interactions. Plant and Animal Genome XIX Conference. San Diego, CA. January 15–17, 2011.

**Park, C.H., Chen, S., Bellizzi, M., Zhou, B., Wang, G.L.** 2010. Understanding the Function of AvrPiz-t in Pathogenesis and Host Defense Interference in Rice. OARDC Annual Research Conference.

**Park, C.H., Chen, S., Bellizzi, M., Zhou, B. Wang, G.L.** Understanding the Function of AvrPiz-t in Pathogenesis and Host Defense Interference in Rice. Fourth International Rice Blast Conference. Little Rock, AK. August 12–14, 2010.

**Paz, H.A., Weiss, P.** 2009. Use of Ash and Nitrogen Concentrations in Manure to Estimate Loss of Ammonia over Time. OARDC Annual Research Conference. Columbus, OH. 2009.

**Qu, J., Hah, C., Jang, J.-C.** The Role of GASA4 and GASA6 in Plant Growth and Development. Plant Molecular Biology and Biotechnology Symposium. Columbus, OH. 2009.

**Qu, J., Hah, C., Kang, S.G., Jang, J.-C.** Are ABA and GA Responses Converged through the Actions of GASA Peptide Hormones? Fifth Annual HCS Graduate Research Retreat. Columbus, OH. 2010.

**Qu, J., Hah, C., Kang, S.G., Jang, J.-C.** Are ABA and GA Responses Converged through the Actions of GASA Peptide Hormones? Ohio Plant Biotechnology Consortium Annual Meeting. Columbus, OH. 2010.

**Qu, J., Hah, C., Kang, S.G., Jang, J.-C.** Are ABA and GA Responses Converged through the Actions of GASA Peptide Hormones? Annual Meeting of the American Society of Plant Biologists. Montreal, Canada. July–August, 2010.

**Qu, J., Hah, C., Kang, S.G., Jang, J.-C.** The Role of a Putative Peptide Hormone in Plant Growth and Development. Annual Meeting of Ohio Plant Biotech Consortium. Columbus, OH. 2009.

**Rajarapu, S.P., Bai, X., Bonello, P., Herms, D.A., Mittapalli, O.** Cytochrome P450 Signatures in the Emerald Ash Borer (*Agrilus planipennis*), an Exotic Invasive Insect Pest. 2010 Annual ESA meeting. San Diego, CA. December 12–15, 2010.

**Rodriguez-Palacios, A., LeJeune, J.T.** Molecular Wild Birds in the Epidemiology of *C. difficile* Conference for Research Workers on Animal Disease. Chicago, IL. December 2008.

**Rodriguez-Palacios, A., LeJeune, J.T.** Clostridium difficile — Is It a Foodborne Pathogen? Institute of Food Technologists. New Orleans, LA. June 2011.

**Rodriguez-Palacios, A., LeJeune, J.T.** Molecular Epidemiology of Clostridium difficile in Finishing Beef Cattle. Conference for Research Workers on Animal Disease. Chicago, IL. December 2009.

**Rong, X., Holford, I., Meulia, T. McSpadden Gardener, B.B.** The Effects of Altering Sequence Assembly and Annotation Settings on Automated Annotations of Bacterial Genomes. Annual Meeting of the American Society of Microbiology. San Diego, CA. May 2010.

**Rong, X., McSpadden Gardener, B.** Development and Application of a qPCR Assay to Track the Spread of a Microbial Biopesticide. WAMBA Seminar. Wooster, OH. December 16, 2011.

**Sam, A.** Impact of Government-Sponsored Pollution Prevention Practices on Environmental Compliance and Enforcement: Evidence from a Sample of U.S. Manufacturing Facilities. Agricultural and Applied Economics Association. Milwaukee, WI. July 2009.

**Teegarden, M., Ahn-Jarvis, J., Schwartz, S., Vodovotz, Y.** Heat Treatment of Soy Flour and Its Effects on Isoflavone Conversion. The Denman Undergraduate Research Forum. Columbus, OH. May 11, 2011.

**Wang, S., Zhao, L.Y., Manuzon, R., Keener, H., Heber, A.** 2010. Prediction of NH<sub>3</sub> emission from confinement dairy housing system using an alternative mass-balance method. American Society of Agricultural and Biological Engineers Conference Proceedings. No. 109409.

**Wang, S., Zhao, L.Y., Wang, X., Manuzon, R., Darr, M., Li, H., Keener, H., Heber, A., Ni, J.** 2009. Estimation of NH<sub>3</sub> Emission from Manure Belt Layer Houses Using an Alternative Mass-Balance Method. ASABE Conference Proceedings. Paper No. 096723.

**Yost, A., Christy, A.D., Zhao, L.Y., Tuovinen, O.** 2012. Impact of Increased Surface Area Cathodes Using Nano-structures on Microbial Fuel Cells Electricity Production. American Society of Agricultural and Biological Engineers Annual Meeting.

**Zhao, W., Michel, A., Goebel, C., Cardina, J.** Analysis of Age and Genetic Structure to Reconstruct a Plant Invasion. OARDC Annual Conference. Columbus, OH. 2011.

**Zhu, J., Li, Y., Cui, F.** Experimental Study on Solid State Anaerobic Digestion of Organic Waste for Methane Production. 2009 Annual Meeting of the American Society of Agricultural and Biological Engineers. Reno, NV. June 2009.

**Zhu, J., Li, Y., Park, S.** Development of an Integrated Anaerobic Digestion System (iADs) for Methane Production from Organic Waste. 2010 Annual Meeting of the American Society of Agricultural and Biological Engineers. Pittsburgh, PA. June 21–23, 2010.

## Publications

### ABSTRACTS

**Carlson, E.M., Chitchumroonchokchai, C., Vodovotz, Y., Schwartz, S.J., Gunn, J.S., Bhatiya, A., Kerem, Z., Berhow, M., Bomser, J.A., Failla, M.L.** 2009. Gastrointestinal Activity of Saponins from Soy and Tomato. *FASEB Journal*. 23:717.15.

**Christy, A.D., Hamid, R.** 2011. Effects of Changing External Resistance in Microbial Fuel Cells. *Ohio Journal of Science*. 111(1): A-7.

**Ellis, M.L., Paul, P.A., St. Martin, S.K., Dorrance, A.E.** 2011. Mapping Partial Resistance to Pythium Irregularis in the Soybean Accession PI 424354. *Phytopathology*. 101: S48.

**Ellis, M.L., Wang, H., Paul, P.A., Dorrance, A.E.** 2011. Mapping Partial Resistance to Fusarium graminearum in 'Conrad' Soybean. *Phytopathology*. 101: S48.

**Lee, S., Mian, R., Wang, H., McHale, L., Sneller, C., Dorrance, A.E.** 2011. Identification of Quantitative Trait Loci Conferring Partial Resistance to Phytophthora sojae in Soybean PI427106. *Phytopathology*. 101: S100.



**Wang, H., Wijeratne, A., Wijeratne, S., Martin, S.K., Dorrance, A.E.** 2011. Comparison of Genes Underlying Two QTL Conferring Partial Resistance to *Phytophthora sojae* from Resistant and Susceptible Soybean Genotypes. *Phytopathology*. 101: S186.

**Zimov, J.L., Botheras, N.A., Hogan, J.S.** 2009. Behavioral and Physiological Responses to Lipopolysaccharide Induced Clinical Mastitis. *Journal of Dairy Science*. 92(E-Suppl. 1):347.

#### ARTICLE PEER REVIEWED

**Binjawadagi, B., Dwivedi, V., Manickam, C., Torrelles, J.B., Renukaradhya, G.J.** 2011. Intranasal Delivery of an Adjuvanted Modified Live Porcine Reproductive and Respiratory Syndrome Virus Vaccine Reduces the ROS Production. *Viral Immunology*. 24(6): 475–482.

**Chen, Y., Irwin, E.G., Jayaprakash, C.** 2009. Dynamic Modeling of Environmental Amenity-Driven Migration with Ecological Feedbacks. *Ecological Economics*. 68: 2498–2510.

**Cheng, J.C., Yuan, C., Graham, T.L.** 2011. Potential Defense-related Prenylated Isoflavones in Lactofen-induced Soybean. *Phytochemistry*. 72: 875–881.

**Cheng, Z., Salminen, S., Grewal, P.S.** 2010. Effect of Organic Fertilisers on the Greening Quality, Shoot and Root Growth, and Shoot Nutrient and Alkaloid Contents of Turf-type Endophytic Tall Fescue, *Festuca arundinacea*. *Annals of Applied Biology*. 156: 25–37.

**Dwivedi, V., Manickam, C., Patterson, R., Dodson, K., Renukaradhya, G.J.** 2011. Intranasal Delivery of Whole Cell Lysate of *Mycobacterium Tuberculosis* Induces Protective Immune Responses to a Modified Live Porcine Reproductive and Respiratory Syndrome Virus Vaccine in Pigs. *Vaccine*. 29(23): 4067–4076.

**Dwivedi, V., Manickam, C., Patterson, R., Dodson, K., Murtaugh, M.P., Torrelles, J.B., Schlesinger, L.S., Renukaradhya, G.J.** 2011. Cross-protective Immunity to Porcine Reproductive and Respiratory Syndrome Virus by Intranasal Delivery of a Live Virus Vaccine with a Potent Adjuvant. *Vaccine*. 29(23): 4058–4066.

**Donald, B., Gertler, M., Gray, M., Lobao, L.** 2010. Re-Regionalizing the Food System? *Cambridge Journal of Regions, Economy and Society*. 3 (2):171–175.

**French, E., Rodriguez-Palacios, A., LeJeune, J.T.** 2010. Enteric Bacterial Pathogens with Zoonotic Potential Isolated from Farm-raised Deer. *Foodborne Pathogens and Disease*. 7 (9): 1031–1037.

**Gardiner, M.M., O’Neal, M.E., Landis, D.A.** 2011. Intraguild Predation and Native Lady Beetle Decline. *PLoS ONE* 6(9): e23576.

**Jeanty, P.W., Partridge, M., Irwin, E.** 2010. Estimation of a Spatial Simultaneous Equation Model of Population Migration and Housing Price Dynamics. *Regional Science and Urban Economics*. 40: 343–352.

**Jun, T.H., Mian, M.A.R., Michel, A.P.** 2012. Genetic Mapping Revealed Two Loci for Soybean Aphid Resistance in PI 567301B. *Theoretical and Applied Genetics*. 124:13–22.

**Kim, Y.C., Leveau, J.H.J., McSpadden Gardener, B.B., Pierson, E.A., Pierson, L.S. III, Ryu, C-M.** 2011. The Multifactorial Basis for Plant Health Promotion by Plant-associated Bacteria. *Applied and Environmental Microbiology*. 77: 1548–1555.

**Lobao, L., Kraybill, D.** 2009. Poverty and Local Governments: Economic Development and Community Service Provision in an Era of Decentralization. *Growth and Change*. 40: 418–451.

**Ma, Y.M., Li, J.R.** 2011. Vesicular Stomatitis Virus as a Vector to Deliver Virus-like Particles of Human Norovirus: A New Vaccine Candidate against an Important Noncultivable Virus. *Journal of Virology*. 85: 2942–2952.

**Ma, Y.M., Wei, Y., Divers, E., Whelan, S.P.J., Li, J.** 2011. The Impact of mRNA Cap Methylation Status on the Pathogenesis of Vesicular Stomatitis Virus in Vivo. *American Society for Virology*. 30: 249, P2-8.

**Mittapalli, O., Bai, X.D., Mamidala, P., Rajarapu, S.P., Bonello, P., Herms, D.A.** 2010. Tissue-specific Transcriptomics of the Exotic Invasive Insect Pest Emerald Ash Borer (*Agrilus planipennis*). *PLoS ONE*. 5: e13708

**Rajarapu, S.P., Mamidala, P., Herms, D.A., Bonello, P., Mittapalli, O.** 2011. Antioxidant Genes of the Emerald Ash Borer (*Agrilus planipennis*): Gene Characterization and Expression Profiles. *Journal of Insect Physiology*. 57: 819–824.

**Rajarapu, S.P., Mamidala, P., Mittapalli, O.** 2012. Validation of Reference Genes for Gene Expression Studies in Emerald Ash Borer (*Agrilus planipennis*). *Insect Science*. 19(1): 41–46.

**Rismani-Yazdi, H., Christy, A.D., Carver, S.M., Yu, Z.T., Dehority, B.A., Tuovinen, O.H.** 2011. Effect of External Resistance on Bacterial Diversity and Metabolism in Cellulose-fed Microbial Fuel Cells. *Bioresource Technology*. 102(1): 278–283.

**Rismani-Yazdi, H., Carver, S.M., Christy, A.D., Tuovinen, O.H.** 2008. Cathodic Limitations in Microbial Fuel Cells: An Overview. *Journal of Power Sources*. 180(2): 683–694.

**Rodriguez-Palacios, A., Lejeune J.T.** 2011. Moist-heat Resistance, Spore Aging, and Superdormancy in *Clostridium difficile*. *Applied and Environmental Microbiology*. 77: 3085–3091.

**Rodriguez-Palacios, A., Pickworth, C., Loerch, S., LeJeune, J.T.** 2011. Transient Fecal Shedding and Limited Animal-to-Animal Transmission of *Clostridium difficile* by Naturally Infected Finishing Feedlot Cattle. *Applied and Environmental Microbiology*. 77: 3391–339, 7.

**Rodriguez-Palacios, A., Koohmaraie, M., LeJeune, J.T.** 2011. Prevalence, Enumeration, and Antimicrobial Agent Resistance of *Clostridium difficile* in Cattle at Harvest in the United States. *Journal of Food Protection*. 74: 1618–1624.

**Roy, E.D., Martin, J.F., Irwin, E.G., Conroy, J.D., Culver, D.A.** 2010. Transient Social-Ecological Stability: The Effects of Invasive Species and Ecosystem Restoration on Nutrient Management Compromise in Lake Erie. *Ecology and Society*. 15(1): 20.

**Sam, A.G., Khanna, M., Innes, R.** 2009. Voluntary Pollution Reduction Programs, Environmental Management, and Environmental Performance: An Empirical Study. *Land Economics*. 85: 692–711.

**Sam, A.G.** 2010. Impact of Government-sponsored Pollution Prevention Practices on Environmental Compliance and Enforcement: Evidence from a Sample of U.S. Manufacturing Facilities. *Journal of Regulatory Economics*. 37: 266–286.

**Westphal, A., Williams, M.L., Baysal-Gurel, F., LeJeune, J.T., McSpadden Gardener, B.B.** 2011. General Suppression of *Escherichia coli* O157:H7 in Sand-based Dairy Livestock Bedding. *Applied and Environmental Microbiology*. 77: 2113–2121.

**Zhang, X.D., Wei, Y.W., Ma, Y.M., Hu, S.H., Li, J.R.** 2010. Identification of Aromatic Amino Acid Residues in Conserved Region VI of the Large Polymerase of Vesicular Stomatitis Virus is Essential for Both Guanine-N-7 and Ribose 2'-O Methyltransferases. *Virology*. 408: 241–252.

**Zimov, J.L.** 2010. Associations among Behavioral and Acute Physiological Responses to Lipopolysaccharide Induced Clinical Mastitis. *International Dairy Federation Animal Health Newsletter*.

**Zimov, J.L., Botheras, N.A., Weiss, W.P., Hogan, J.S.** 2011. Associations among Behavioral and Acute Physiologic responses to Lipopolysaccharide-induced

Clinical Mastitis in Lactating Dairy Cows. *American Journal of Veterinary Research*. 72(5):620–627.

## BOOK CHAPTERS

**Geng, X., Mackey, D.** 2011. Dose-response to and Systemic Movement of Dexamethasone in the GVG-inducible Transgene System in Arabidopsis. *Plant Immunity: Methods and Protocols Methods in Molecular Biology*. 712: 59–68.

**Grewal, P.S.** 2012. From Integrated Pest Management to Ecosystem Management: The Case of Urban Lawn. In *Integrated Pest Management: Principles and Practice*. Edited by Abrol, D.P. Wallingford, UK: CABI Publishing (in press).

**Irwin, E.G., Randall, A.J., Chen, Y.** 2008. “Exploring the Prospects for Amenity-Driven Growth in Rural.” in *Frontiers in Resource and Rural Economics: Human-Nature, Rural-Urban Interdependencies*, edited by JunJie Wu, Paul W. Barkley, and Bruce A. Weber. Washington, DC, Resources for the Future, Chapter 6.

## STUDENT FUNDING

**Ciotola, R.**, PhD. Microbial Communities in Small-Scale Digesters. Autumn 2011.

**Crockett, R.**, Masters. The physicochemical properties of gluten-free dough with the addition of hydrocolloids and proteins. Autumn 2009.

**Davidson-Bennett, K.**, Masters. Watershed urbanization impacts to headwater streams in northeastern Ohio. Spring 2011.

**Ellis, M.L.**, PhD. Decoding and managing *Pythium* spp. and *Fusarium graminearum*. Winter 2011.

**Hu, J.**, PhD. Whole genome analysis of two fungal plant pathogens. Spring 2012.

**Qu, J.**, PhD. The role of GASA peptide hormone in plant growth and development. 4 2012.

**Yost, A.**, Masters. The development microbial fuel cell with nono-structure electrode for enhance power generation. Fall 2011.

## Past Funded Projects

### 1996

#### **Francis, David M.**

*Horticulture and Crop Science*

Development of Molecular Marker Systems to Improve Management of Resistance to Bacterial Spot of Tomato

#### **Logan, Terry J.**

*School of Environment and Natural Resources*

Synthetic Soil Manufacture with Waste Products

#### **Saif, Linda J.**

*Food Animal Health Research Program*

Introduction of Bovine Rotavirus Capsid Protein Genes into Corn and Soybeans for Use as an Edible Oral Vaccine in Calves

#### **Yousef, Ahmed E.**

*Food Science and Technology*

Production of Bacteriocins in Whey Permeate Using a Novel Continuous Immobilized Cell Bioreactor

### 1997

#### **Batte, Marvin T.**

*Agricultural, Environmental and Development Economics*

An Economic Evaluation of Emerging Variable Rate Applications Technologies

#### **Fluharty, Francis L.**

*Animal Sciences*

Genetic and Nutritional Factors Affecting Muscle Characteristics and Carcass Value of Beef Cattle

#### **Gordon, Donald T.**

*Plant Pathology*

Evaluation of Resistance to Obligately Vector Transmitted Maize Viruses by Vascular Puncture Inoculation

#### **Hoitink, Harry A.**

*Plant Pathology*

Biological Control of Xanthomonas (bacterial) Diseases Based on Systemic Acquired Resistance

#### **McCune, Sylvia A.**

*Food Science and Technology*

Studies in Progression to Arteriosclerosis and Heart Failure: The Role of Cardiac Extracellular Matrix Remodeling

#### **Riedel, Richard M.**

*Plant Pathology*

Development of Technology for Saturation Culture of Soybean

### 1998

#### **Allred, John B.**

*Food Science and Technology*

Carbohydrate Stimulation of Fat Synthesis in Humans

#### **Bray, Tammy M.**

*Education and Human Ecology*

The Prophylactic Effects of Vitamin E and Aspirin on 3-Methylindole and Bovine Respiratory Syncytial Virus Induced Respiratory Disease in Feedlot Cattle

#### **Chern, Wen S.**

*Agricultural, Environmental and Development Economics*

China's Food Demand and Global Food Security

#### **Dabrowski, Konrad**

*School of Environment and Natural Resources*

Biotechnology of Microencapsulation as a Delivery System of Nutrients and Macro-Molecules for Fresh Water and Marine Fish Larvae

#### **Dick, Warren A.**

*School of Environment and Natural Resources*

Microbial Community Structure in Coal Mine Overburden and Wastes

#### **Dick, Warren A.**

*School of Environment and Natural Resources*

Chemical Free No-Tillage Crop Production

#### **Dickson, Marsha A.**

*Consumer and Textile Sciences*

Competitiveness of U.S. Natural Fiber Apparel Products in China

#### **Francis, David M.**

*Horticulture and Crop Science*

Mapping Resistance to Bacterial Canker in Tomato

#### **Graham, Terrence L.**

*Plant Pathology*

Are Estrogen Response Pathways Involved in Activation of Defense Potential in Soybean?



**Grewal, Parwinder S.***Entomology*

Heat Shock Proteins of Entomopathogenic Nematodes

**Hitzhusen, Fredrick J.***Agricultural, Environmental and Development Economics*

Soil Erosion and Recreational Boating Values

**Lagrimini, Mark***Horticulture and Crop Science*

Optimization of the Tobacco Anionic Peroxidase for Improving Insect Resistance in Genetically Altered Crops

**Mancl, Karen M.***Food, Agricultural and Biological Engineering*

Renovation of Food Processing Wastewaters with Aerobic Fixed-Film Bioreactors

**Pasian, Claudio C.***Horticulture and Crop Science*

Developing an Environmentally Sound Application Method of Systemic Chemicals for the Floriculture Industry

**Pratt, Richard C.***Horticulture and Crop Science*

Grain Quality Enhancement of U.S. Maize Using Molecular Marker Assisted Selection to Exploit Genetic Diversity of Tropical Maize

**Sheldon, Ian M.***Agricultural, Environmental and Development Economics*

Agricultural Trade and Exchange Rate Uncertainty

**St. Martin, Steven K.***Horticulture and Crop Science*

Modification of Fatty-Acid Profile of Ohio Soybean Varieties

**Streeter, John G.***Horticulture and Crop Science*

Effect of Soybean Seed Exudate on Seed Adhesion and Survival Rhizobia

**1999****Yousef, Ahmed E.***Food Science and Technology*

Ozone Treatment of Apple to Improve the Safety of Cider

**Christy, Ann D.***Food, Agricultural and Biological Engineering*

Solid Waste Bioremediation Using in-situ Landfill Bioreactor Technology

**Courtney, Polly D.***Food Science and Technology*

Cloning and Characterization of a Bacterial Linoleic Acid Isomerase Gene for Improving Production of cis-9, trans-11-Conjugated Linoleic Acid

**Dick, Warren A.***School of Environment and Natural Resources*

Flue Gas Desulfurization By-Products Provide Sulfate and Trace Mineral Nutrition for Alfalfa and Soybean

**Disilvestro, Robert A.***Human Nutrition*

Soy Antioxidant Actions in Humans

**Dorrance, Anne E.***Plant Pathology*Evaluation of the Field Response of Soybean Lines with Partial Resistance of to *Phytophthora sojae***Ferree, David C.***Horticulture and Crop Science*

Apple Rootstocks — Evaluation and Influences of Soil Compaction

**Grewal, Parwinder S.***Entomology*

Developing Molluscicidal Nematodes for Biological Control of Pest Slugs

**Grewal, Parwinder S.***Entomology*

Building an Ecosystem Approach to Pest Management in Turfgrass: Evaluating Interactions among Endophytes, Herbivores, and Weeds

**Herms, Daniel A.***Entomology*

The Flowering Sequence of Ornamental Plants and Degree-Day Models as Tools for Predicting the Phenology of Insect Pests in Lake County Nurseries

**Herms, Daniel A.***Entomology*

Soil Management Regimes for Plant Health Care and Integrated Pest Management Programs in Urban Landscapes

**Howe, Glenn T.***School of Environment and Natural Resources*

Genetic Architecture of Fraser Fir, an Economically Important and Threatened Forest Tree

**Jakes, Kathryn A.**

*Consumer and Textile Sciences*

Evaluation of the Effect of Diet on the Quality of Alpaca Fleece Fiver: Phase I. Determination of Effective Performance Evaluation Parameters

**Kaletunc, Gonul**

*Food, Agricultural and Biological Engineering*

Influence of Emulsifiers on Storage Stability of Corn Exudates

**Kamoun, Sophien**

*Plant Pathology*

Unraveling the Phytophthora Transcriptome: Toward Novel Methods of Disease Control

**Kamoun, Sophien**

*Plant Pathology*

Phytophthora sojae Genes Encoding Secreted Proteins: The Search for a Pathogen Achilles Heel

**Ling, Peter P.**

*Food, Agricultural and Biological Engineering*

Development of a Machine Vision Based Early Plant Stress Detection System

**Meulia, Tea**

*Electron Microscopy Lab–MCIC*

Construction of a Maize Dwarf Mosaic Virus (MDMV) Infectious Clone to Study Maize Resistance

**Michel, Frederick C.**

*Food, Agricultural and Biological Engineering*

Aeration and Nitrogen Amendment Strategies to Improve Composting Rate and Reduce Odor Release During Urban Leaf Composting

**Mitsch, William J.**

*School of Environment and Natural Resources*

Use of Clean Coal Technology Products in the Construction of Low Permeability Liners

**Morishita, Teresa Y.**

*Veterinary Preventive Medicine*

Portal of Entry, Localization, and Invasion of Pasteurella multocida

**Nameth, Stephen T.**

*Plant Pathology*

Possible Seed Transmission of Impatiens Necrotic Spot Virus and Tomato Spotted Wilt Virus in Flowering Bedding Plants and Herbaceous Perennials

**Quigley, Martin F.**

*Horticulture and Crop Science*

Improving Groundcover Establishment under Shade Trees through Mixed Species Installation

**Saif, Linda J.**

*Food Animal Health Research Program*

Pathogenecity Studies of Dual Infection of Nursery Pigs with Porcine Reproductive and Respiratory Syndrome Virus and Porcine Coronavirus

**Saif, Y. Mo**

*Food Animal Health Research Program*

Egg Yolk Derived Specific Immunoglobulin (IgY) for Prevention of Riemerella Anatipestifer Infection in Pekin Ducks (Anas platyrhynchos)

**Schwartz, Steven J.**

*Food Science and Technology*

Bioavailability of Lycopene from Fresh and Processed Tomatoes

**Sharp, Jeff S.**

*School of Environment and Natural Resources*

The Social Impacts of Rural In-Migration on Ohio Agriculture and Communities and the Rural/Urban Interface: Two Case Studies

**Shellhammer, Thomas H.**

*Food Science and Technology*

Pressure Induced Modifications of Pectin Degrading Enzymes

**Sweeney, Patricia M.**

*Horticulture and Crop Science*

Dormant Seeding of Cool Season Turfgrass Species

**Taylor, R.A.J.**

*Entomology*

Predicting Insect Pest Populations at Synoptic and Local Scales: A Pilot Study with Gypsy Moth in Ohio

**Taylor, R.A.J.**

*Entomology*

Potential Influence of Coir on Western Flower Thrips Survival and Damage

**Velleman, Sandra G.**

*Animal Sciences*

The Role of Muscle Integrin Receptors in Chicken Skeletal Muscle Formation

**Weiss, William P.***Animal Sciences*

Influence of Supplemental Biotin on Chemical, Histological, and Clinical Changes in Hoof Horn of Intensively Managed Dairy Cattle

**Wick, Macdonald P.***Animal Sciences*

Mechanical Extraction of Intramuscular Lipids from Lamb

**Williams, Roger A.***School of Environment and Natural Resources*

Quantifying Vertical Structure in Oak-Hickory Forests of Ohio

**Yousef, Ahmed E.***Food Science and Technology*

Mechanism of Inactivation of Foodborne Pathogens by Pulsed Electric Fields

**Zhang, Howard Q.***Food Science and Technology*

PEF Consortium for Technology Commercialization

**Zhang, Qijing***Animal Sciences*

Identification of *Campylobacter* *Jejuni* Genes Critical for Colonization of Chickens

**Zhang, Qijing***Animal Sciences*

Development of Sensitive and Rapid Methods for Detecting *Campylobacter* Infection in Poultry

**2000****Allred, Barry J.***Agricultural, Environmental and Development Economics*

Location of Agricultural Subsurface Drainage Systems Using Geophysical and Geotechnical Methods

**Bacon, Wayne L.***Animal Sciences*

The Effects of Lighting Program (Intermittent vs. Continuous Lighting) and Light Intensity (Very Low, Moderate, or High) from an Early Age on Semen Production of Commercial Strain of Breeder Male Turkeys

**Bonello, Pierluigi***Plant Pathology*

Systemic Effects of *Sphaeropsis* *Sapinea* on the Secondary Metabolism of *Ponderosa* and *Scots Pine*

**Cardina, John***Horticulture and Crop Science*

Methods Development for Predicting and Mapping Invasive Plant Habitat

**Wen, S.***Agricultural, Environmental and Development*

Economics Impacts of Consumer Health Concerns on Food Demand in Europe

**Christy, Ann D.***Food, Agricultural and Biological Engineering*

Microbial Biomass and Activity in Landfills

**Dabrowski, Konrad***School of Environment and Natural Resources*

Production of All-Female Triploid Yellow Perch for Commercial Aquaculture

**Day, Michael L.***Animal Sciences*

Effects of Estradiol on the Interactions of Estrus, Follicular Development and Ovulation in Cattle

**Frey, Serita D.***School of Environment and Natural Resources*

Linking Soil Fungal: Bacterial Biomass Ratios to Carbon Sequestration in Agroecosystems

**Gates, Robert J.***School of Environment and Natural Resources*

Evaluation of Managed and Unmanaged Wetlands as Migratory Bird Habitat in the Upper Mississippi River and Great Lakes Region Joint Venture

**Graham, Terrence L.***Plant Pathology*

Differential Regulation of Local and Induced Systemic Resistance in Soybean by Peroxisome Proliferators and Redox Active Compounds

**Graham, Terrence L.***Plant Pathology*

Role of the Soybean Kunitz Trypsin Inhibitor in General (Partial) Disease Resistance

**Grewal, Parwinder S.***Entomology*

Biology and Control of Foliar Nematodes on *Hosta* and Other Nursery Ornamentals



**Grewal, Parwinder S.**

*Entomology*

Developing a Novel White Grub Control Strategy Based on the Synergism Between Entomopathogenic Nematodes and Imidacloprid

**Grewal, Parwinder S.**

*Entomology*

Developing a New Environmentally Safe Nematicide for Controlling Plant-parasitic Nematodes

**Hogan, Joseph S.**

*Animal Sciences*

Growth Responses of Coliform Bacteria to Antibodies against the Ferric Citrate Receptor FecA

**Hogenhout, Saskia A.**

*Entomology*

The Development of Basic Tools for Studying the Molecular Interactions Between the Corn Stunt Spiroplasma and its Dalbulus Leafhopper Vectors

**Jakes, Kathryn A.**

*Consumer and Textile Sciences*

Effect of Protein and Calorie Restriction on Fiber Production in Alpacas

**Jang, Jyan-Chyun**

*Horticulture and Crop Science*

Extra-Long-Lifespan, Implication of Plant Steroid Hormone Function in Apical-basal Patterning in Arabidopsis thaliana

**Kamoun, Sophien**

*Plant Pathology*

Combining Genomics and Proteomics of Extracellular Proteins in Economically Important Phytophthora

**Kamoun, Sophien**

*Plant Pathology*

Ribozyme-Mediated Disruption of Gene Expression in Plants and Phytophthora

**Kleinhenz, Matthew D.**

*Horticulture and Crop Science*

Increasing the Health and Potential Market Value of Ohio Vegetables

**Kleinhenz, Matthew D.**

*Horticulture and Crop Science*

New Commodity Enterprises in Ohio — Evaluation and Education

**Koontz, Tomas M.**

*School of Environment and Natural Resources*

Land Use Decisions in Ohio: Combining Top-Down and Bottom-Up Policy Approaches

**Ling, Peter P.**

*Food, Agricultural and Biological Engineering*

Drought Stress Detection for Water Management of New Guinea Impatiens

**McDonald, Miller B.**

*Horticulture and Crop Science*

Computer Imaging to Improve Flower and Vegetable Seed Quality and Performance

**Michel, Frederick C.**

*Food, Agricultural and Biological Engineering*

Use of DNA-based Methods to Analyze Microbial Communities in Soils that Induce Plant Disease Systemic Resistance

**Morishita, Teresa Y.**

*Veterinary Preventive Medicine*

Survival of Ascaridia Dissimilis ova on Turkey Egg Shell Surfaces

**Napier, Teddy L.**

*Human and Community Resource Development*

Use of Climate Projections in Farm-Level Agricultural Production Decision Making

**Napier, Teddy L.**

*Human and Community Resource Development*

Ohio Statewide Outdoor Facilities Inventory Update

**Ozkan, Erdal**

*Food, Agricultural and Biological Engineering*

Low Cost GPS-Based Sensors for High Speed Agricultural Vehicle Guidance

**Saif, Linda J.**

*Food Animal Health Research Program*

Rotaviruses: Molecular Characterization from Different Animal Species

**Saif, Linda J.**

*Food Animal Health Research Program*

Development of a Respiratory Disease Challenge Model in Colostrum-Deprived Calves Using Respiratory Strains of Bovine Coronavirus Isolated from Feedlot Cattle

**Saif, Linda J.***Food Animal Health Research Program*

Isolation and Characterization of New Field Strains of Transmissible Gastroenteritis Virus (TGEV) and Porcine Respiratory Coronavirus (PRCV)

**Saif, Linda J.***Food Animal Health Research Program*

Development of Nested PCR for Differential Diagnosis of Transmissible Gastroenteritis Virus (TGEV) and Porcine Respiratory Coronavirus (PRCV) from Feces and Nasal Swabs of Infected Pigs

**Schwartz, Steven J.***Food Science and Technology*

Assessment of Human Intestinal Absorption of Carotenoids from Tomato Varieties with Different Pigment Content, Structure and Distribution

**Slater, Brian K.***School of Environment and Natural Resources*

Soil-Landscape Modeling of Organic Carbon Dynamics Across Multiple Scales

**Sulc, Reuben M.***Horticulture and Crop Science*

Biotic and Abiotic Stress Effects on Alfalfa Persistence

**Taylor, R.A.J.***Entomology*

Population Dynamics of an Entomopathogenic Nematode: Analyzing a Sustained Inoculative Release of *Heterorhabditis bacteriophora*

**Thraen, Cameron S.***Agricultural, Environmental and Development Economics*

The Futures and Options Market and Medium to Small Scale Dairying: Implication for Long-term Economic Viability of the Ohio Dairy Industry

**Thraen, Cameron S.***Agricultural, Environmental and Development Economics*

The National Program for Dairy Risk Management Education and Research

**Wang, Guo-Liang***Plant Pathology*

High Resolution Mapping of the Pi9(t) Locus

**Wang, Guo-Liang***Plant Pathology*

Linkage Analysis of ESTs Mapped onto the Regions Containing Major Resistance Genes and Resistance QTLs to Rice Blast

**Zhang, Howard Q.***Food Science and Technology*

Phase 2. PEF Consortium for Technology Commercialization

**Zhang, Qijing***Animal Sciences*

Development of a Novel Mutagenesis System for Identification of Virulence-Associated Genes in *Campylobacter jejuni*

**2001****Barker, David***Horticulture and Crop Science*

The Interaction Between Biodiversity and Water Deficit on Forage Biomass Characteristics

**Barker, David***Horticulture and Crop Science*

Application of Biodiversity Theory to Species Mixtures for Grazing

**Barker, David***Horticulture and Crop Science*

Population Stability in Endophyte-Free Novel-Endophyte Tall Fescue Pastures

**Barringer, Sheryl***Food Science and Technology*

Learning Techniques for Powder Flow Measurements

**Bauer, Wolfgang D.***Horticulture and Crop Science*

Proteomic-Genomic Analysis of Symbiotic and Pathogenic Behaviors in Bacteria Affected by Signal-Mimic Compounds from Crop Plants

**Bomser, Joshua A.***Human Nutrition*

Effects of Lycopene on Oxidant-Induced Mitogen-activated Protein Kinase (MAPK) cascades in Human Prostate Epithelial Cells

**Bouchard, Virginie L.***School of Environment and Natural Resources*

Potential for Restoration of Ditched to Control Non-Point Sources Pollution and Improve Water Quality in Ohio

**Courtney, Polly D.***Food Science and Technology*

The Role of Gluconate Metabolism in the Colonization and Persistence of *Lactobacillus* in the Mouse Intestine

**Courtney, Polly D.**

*Food Science and Technology*

Improvement of *Lactobacillus Acidophilus* Stress Tolerance by Altering Membrane Fatty Acid Composition

**Courtney, Polly D.**

*Food Science and Technology*

Salt and Cold Tolerances of *Propionibacterium* and their Effect on Eye Formation and Split Defect in Swiss Cheese

**Dabrowski, Konrad**

*School of Environment and Natural Resources*

Development of Fish Vaccines Using Recombinant Phage Display Libraries

**Dabrowski, Konrad**

*School of Environment and Natural Resources*

Activity-Guided Fractionation of Phytochemicals for Growth Enhancement of Fish

**Dorrance, Anne E.**

*Plant Pathology*

New Syndrome-New Pests in Soybeans: What Will the Impact(s) Be to Ohio Producers?

**Fike, Karol E.**

*Animal Sciences*

Decreasing Age Puberty in Bulls with Luteinizing Hormone-Releasing Hormone (LHRH) Agonists

**Fike, Karol E.**

*Animal Sciences*

Enhancing Fertility of Bulls with Luteinizing Hormone-Releasing Hormone (LHRH) Agonists

**Firkins, Jeffrey L.**

*Animal Sciences*

Development and Use of Molecular Technologies to Study Nitrogen Transactions in the Rumen to Reduce Nitrogen Excretion into the Environment

**Grewal, Parwinder S.**

*Entomology*

A Novel Approach to Expanding the Zone of Entomopathogenic Nematode Efficacy from the Soil to Foliage

**Hitzhusen, Fredrick J.**

*Agricultural, Environmental and Development Economics*

Estimating Social Benefits from Increases in River and Stream Protection

**Hogenhout, Saskia A.**

*Entomology*

Dissection of Response Mechanisms to Mollicute Infections of Leafhoppers in Laboratory and Field Conditions

**Hogenhout, Saskia A.**

*Entomology*

The Characterization of Candidate Genes Associated with Host Specificity and Symptom Development of Aster Yellows and Maize Bushy Stunt Phytoplasmas

**Hooker, Neal H.**

*Agricultural, Environmental and Development*

Economics The Drive to Single Food Safety Agencies: Learning from the Experiences of Others

**Hoy, Casey W.**

*Entomology*

Landscape Pattern Indicators of Agroecosystem Health

**Kaletunc, Gonul**

*Food, Agricultural and Biological Engineering*

Modeling of Thermal Conductivity of Porous Food and Agricultural Materials for Value-Added Processing

**Kovach, Joseph**

*Entomology*

Using Bees to Deliver Biological and Chemical Controls to Apples for the Management of Mites and Fire Blight

**Lal, Rattan**

*School of Environment and Natural Resources*

Carbon Sequestration in Managed Ecosystems of Ohio

**Martin, Jay F.**

*Food, Agricultural and Biological Engineering*

The Effects of Macrophyte Water Uptake on Nitrogen Removal from Wetland Treatment Systems

**Martin, Jay F.**

*Food, Agricultural and Biological Engineering*

Concurrent Treatment of Nursery Pad Effluent and Agricultural Stormwater with a Constructed Wetland Treatment System

**McFeeters, Don**

*Centers at Piketon*

Eliminating Barriers to the Economical Production of Yellow Perch (*Perca Flavescens*) in Ohio

**Miller, Diane D.**

*Horticulture and Crop Science*

Spring Frost Resistance: Identifying Germplasm for Use in Midwest Apple Variety Improvement



**Morishita, Teresa Y.***Veterinary Preventive Medicine*

Characterization of Lipopolysaccharides from  
Untypable *Pasteurella Multocida* Isolates from Turkeys

**Ottobre, Joseph S.***Animal Sciences*

Role of Vitamin C transporters and Prostaglandin Synthase  
in Vitamin C Depletion during Regression of the Ovine  
Corpus Luteum

**Pasian, Claudio C.***Horticulture and Crop Science*

Controlling Early Growth of Plugs

**Pope, William F.***Animal Sciences*

Expression of the Androgen Receptor During Follicular  
Development and Estrous Cycle in Swine

**Redinbaugh, Margaret G.***Plant Pathology*

The Identity and Role of Maize Rio Cuarto Virus in Mal de  
Rio Cuarto Disease of Maize

**Regnier, Emilie E.***Horticulture and Crop Science*

Inheritance of ALS Herbicide Resistance in Giant  
Ragweed: Investigation of Mating System and Gene  
Flow in Natural Populations

**Rodewald, Amanda D.***School of Environment and Natural Resources*

A Multi-Scale Analysis of Landscape Matrix Effects  
on Riparian Forests: Implications for Wildlife Conservation  
and Buffer Design

**Seiling, Sharon L.***Ohio State University Extension*

Family Sustainability in the Era of Welfare Reform:  
The Role of Human Capital, Social Capital, Family  
Resiliency, Community Support, and Economic  
Opportunity in the Lives of Rural Low Income Families

**Sreevatsan, Srinand***Food Animal Health Research Program*

Rapid Identification of Scrapie-Infected Animals  
Using Surrogate Biochemical Markers in Cerebrospinal  
Fluid and Plasma

**St. Martin, Steven K.***Horticulture and Crop Science*

Development of Glyphosate-Resistant Soybean  
Cultivars with Improved Resistance to *Phytophthora* Rot

**Stockinger, Eric J.***Horticulture and Crop Science*

The Organization, Structure and Functional Role of the  
Glycine CBF Protein-Encoding Genes and Regulon in  
Mediating Cold, Drought and Salinity Tolerance in Soybean

**Thomison, Peter R.***Horticulture and Crop Science*

Nitrogen Fertility Effects on Supercede Corn Production

**Wick, Macdonald P.***Animal Sciences*

Early Determination of Tenderness in Beef Carcasses

**Zhang, Howard Q.***Food Science and Technology*

Product Development and Potential Market Analysis of  
PEF Processed Juices

**2002****Apsley, David***Ohio State University Extension*

Freshwater Shrimp Production in Southern Ohio

**Bennett, Mark A.***Horticulture and Crop Science*

Integrating Bio-Cultural Components in Organic Corn  
and Soybean Seed Production

**Bomser, Joshua A.***Human Nutrition*

Carotenoids and Age-Related Cataracts

**Dabrowski, Konrad***School of Environment and Natural Resources*

Bring Back the Natives! Use of Biotechnology to  
Restore Sturgeon Populations in the Great Lakes

**Delwich, Jeannine F.***Food Science and Technology*

Examination of Individual Differences in Perception  
of Sweeteners for the Development of Improved High-  
potency Sweetener Blends

**Doohan, Douglas***Horticulture and Crop Science*

Comparing Weed Communities on Paired Organic and  
Conventional Farms Across Ohio

**Ehsani, Mohammad R.***Food, Agricultural and Biological Engineering*

A Precision Agriculture Study for Ohio Strawberry Production

**Ehsani, Mohammad R.**

*Food, Agricultural and Biological Engineering*

Developing Test Procedure for Evaluating the Accuracy and Efficiency of Global Positioning System (GPS) Based Guidance Systems

**Ellis, Michael A.**

*Plant Pathology*

Evaluation of Preharvest Fungicide Applications and Cold Storage for Postharvest Control of Botrytis Fruit (Gray Mold) on Raspberry

**Goebel, Charles**

*School of Environment and Natural Resources*

Best Management Practices in Agricultural Landscapes

**Grewal, Parwinder S.**

*Entomology*

Developing Preventive Strategy for the Management of Foliar Nematodes on Hostas

**Hogenhout, Saskia A.**

*Entomology*

Negative Sense Viral Vectors for Improved Expression of Foreign Genes in Insects and Plants

**Hoy, Casey W.**

*Entomology*

Development of Rapid and Sensitive PCR Methods for Detection of the Causal Agent of Stolbur Disease on Potato and Integrated Approaches to Its Management

**Jones, Michelle L.**

*Horticulture and Crop Science*

Flower Senescence in Ethylene Sensitive and Insensitive Petunias

**LeJeune, Jeffrey T.**

*Food Animal Health Research Program*

Foodborne Pathogens in Cull Dairy Cattle

**LeJeune, Jeffrey T.**

*Food Animal Health Research Program*

Automated Immunomagnetic Separation-ELISA for the Detection of Shiga Toxin Producing Escherichia coli (STEC) from Cattle

**LeJeune, Jeffrey T.**

*Food Animal Health Research Program*

An International Approach to Pre-harvest Escherichia coli O157 Food Safety

**LeJeune, Jeffrey T.**

*Food Animal Health Research Program*

Effects of Trough Design on Microbial Contamination of Livestock Drinking Water

**Mathers, Hannah M.**

*Horticulture and Crop Science*

High Temperature Stress Effects on Water Use and Nutrient Utilization in Container Systems

**McSpadden Gardener, Brian B.**

*Plant Pathology*

Improved Molecular Profiling of Microbial Communities Inhabiting Agricultural Soils

**Miller, Sally A.**

*Plant Pathology*

Sustainable Management of Rhizoctonia solani in Vegetable Crops

**Mitsch, William J.**

*School of Environment and Natural Resources*

Effects of Hydrologic Pulses on the Effectiveness of Wetlands to Control Agricultural Runoff of Nitrogen-Biochemical and Economic Modeling

**Moore, Richard H.**

*School of Environment and Natural Resources*

Improving Livestock and Grain Farmers' Contribution to Environmental Quality through Headwaters Learning Communities

**Morrison, Mark**

*Animal Sciences*

A Collaborative Research Program Between the MAPLE Research Team and The Department of Animal Science at The University of Melbourne, Australia

**Napier, Teddy L.**

*Human and Community Resource Development*

Willingness of Local Populations to Participate in the Formulation and Implementation of Development Programs within the Muskingum Watershed

**Pasian, Claudio C.**

*Horticulture and Crop Science*

Improving Cultural Practices of Osteospermum: Vernalization and Growth Control

**Rhodes, Landon H.**

*Plant Pathology*

Occurrence and Control of Microdochium Blight in Commercial Pumpkins and Gourds

**Roe, Brian E.***Agricultural, Environmental and Development*

Economics An Experimental Approach to Understanding  
and Improving the Contracting Choices of Corn Belt Hog  
Producers

**Sharp, Jeff S.***School of Environment and Natural Resources*

Understanding Exurban Change in Ohio and the Midwest

**Smith, Anne M.***Human Nutrition*

Effect of Estrogen on Selenium Distribution

**Sreevatsan, Srinand***Food Animal Health Research Program*

Molecular Diagnostics and Epidemiology of  
Mycobacterium Paratuberculosis

**Sreevatsan, Srinand***Food Animal Health Research Program*

Development of Methods to Detect and Destroy Prions  
in Foods

**Sulc, Reuben M.***Horticulture and Crop Science*

Economic Thresholds in Potato Leafhopper Resistant  
Alfalfa Cultivars

**van der Knaap, Esther***Horticulture and Crop Science*

Map-based Cloning of SUN, A Gene Controlling Variation  
in Tomato Fruit Shape

**Velleman, Sandra G.***Animal Sciences*

Development of Cardiac Fibroblast Cell Culture  
Methodology

**Vodovotz, Yael***Food Science and Technology*

Effect of CMC on the Physical-Chemical Properties of  
Masa-Water Mixtures

**Wang, Hua***Food Science and Technology*

Role of Cell-cell Communication on Gram-positive  
Bacterial Biofilm Formation in the Food Environment

**Ward, Lucy A.***Food Animal Health Research Program*

A Non-pharmaceutical Approach for Treatment of  
Prevention of Cryptosporidium Parvum Infections

**Zhang, Qijing***Animal Sciences*

Antigenic and Structural Characterization of Campylobacter  
Major Outer Membrane Protein

**2003****Arvai, Joseph L.***School of Environment and Natural Resources*

Improving Stakeholder Consultation Processes for  
Environmental Restoration Decisions Involving the  
Reinstatement of Natural Fire Regimes

**Bennett, Mark A.***Horticulture and Crop Science*

Cabbage, Carrot, Snap Bean and Sweet Corn Seed  
Vigor Analysis for Improved Seedling Establishment

**Bennett, Mark A.***Horticulture and Crop Science*

Vegetable Transplants as a Delivery System for Biocontrol  
Agents

**Bonello, Pierluigi***Plant Pathology*

Molecular Biology and Anatomy of Systemic Induced  
Resistance in Austrian Pine

**Day, Michael L.***Animal Sciences*

Twin Births in Cattle: Development of Systems to Induce  
Twinning and Factors Responsible for the Occurrence of  
Twin Births in Cattle

**Delwich, Jeannine F.***Food Science and Technology*

Determining what Characteristics Consumers Desire in  
Swiss Cheese

**Dick, Warren A.***School of Environment and Natural Resources*

Improved Soil Quality and Increased Carbon Credits  
Through the Use of FGD-Gypsum to Enhance No-Tillage  
Crop Production

**Disilvestro, Robert A.***Human Nutrition*

Exercise Recovery Enhancement by Berry-Soy Isoflavone  
Beverages

**Disilvestro, Robert A.***Human Nutrition*

Anti-Inflammatory Effects of Alfalfa Saponins



**Doohan, Douglas**

*Horticulture and Crop Science*

Comparative Biology, Management, and Herbicide Resistance in Weeds Invading Vineyards in Ohio and Chile

**Doohan, Douglas**

*Horticulture and Crop Science*

Identifying Candidate Herbicides for Managing Apple of Peru (*Nicandra physalodes*) in Vegetable and Field Crops

**Finer, John J.**

*Horticulture and Crop Science*

High Throughput Digital Image Analysis for Promoter Analysis in Transiently Transformed Plant Tissues

**Goebel, Charles**

*School of Environment and Natural Resources*

Influence of Landscape Hierarchies on the Structure and Function of Riparian Plant Communities in Beech-Maple Forest Ecosystems of the Lower Great Lakes

**Grewal, Parwinder S.**

*Entomology*

Determining the Mechanism of Symbiosis between the Slug-parasitic Nematode *Phasmarhabditis hermaphrodita* and Associated Bacteria

**Grewal, Parwinder S.**

*Entomology*

Commercial Potting Media as Carriers for Entomopathogenic Nematodes: A Novel Approach to Biological Pest Control in Floriculture

**Herms, Daniel A.**

*Entomology*

Effects of Urban Soil Management Practices on Soil Ecology, Tree Carbon Allocation, Insect Resistance, and Stress Tolerance in an Inverted Subsoil Profile

**Holmes-McNary, Minnie**

*Human Nutrition*

Effects of Grape Components on Health and Gene Expression

**Jang, Jyan-Chyun**

*Horticulture and Crop Science*

Map Sugar Signal Transduction Network in Plants through a Global Understanding of Gene Expression Using GeneChip Assisted DNA Microarray Analysis

**Martin, Jay F.**

*Food, Agricultural and Biological Engineering*

An Ecological System to Treat Dairy Wash-water and Generate Value-added Products: The Waterman Ecological Treatment System (WETS)

**Martin, Jay F.**

*Food, Agricultural and Biological Engineering Grant*

U.S. Department of Agriculture (USDA) Higher Education Challenge Grant

**Miller, Sally A.**

*Plant Pathology*

Biorational Tactics for Early Control of Bacterial Spot and Bacterial Canker of Tomatoes

**Ottobre, Joseph S.**

*Animal Sciences*

Manipulation of Vascular Endothelial Growth Factor (VEGF) to Regulate Reproductive Efficiency

**Precheur, Robert J.**

*Horticulture and Crop Science*

Optimizing Bell Pepper, Pumpkin and Sweet Corn Production in OH through Cultivar Selection for Desirable Traits and Disease Resistance

**Reynolds, Christopher K.**

*Animal Sciences*

Gut Peptides and Feed Intake of Cattle

**Rhodes, Landon H.**

*Plant Pathology*

Occurrence and Control of Microdochium Blight of Pumpkins and Gourds (*Plectosporium tabacinum*): Weed Hosts and Over-wintering Sites

**Rhodes, Landon H.**

*Plant Pathology*

Occurrence and Control of the Fescue and Ryegrass Toxicosis Endophytes in Ohio Dairy Pastures

**Schwartz, Steven J.**

*Food Science and Technology*

Assessment of Human Intestinal Uptake of Carotenoid Phytochemicals

**Sreevatsan, Srinand**

*Food Animal Health Research Program*

Detection of *Mycobacterium avium* subsp. *paratuberculosis* in Bovine Fecal Samples by PCR Amplification: Evaluation of the Combination of Phytase Treatment with CB-18 Specimen Processing to Enhance Diagnostic Sensitivity

**Sulc, Reuben M.**

*Horticulture and Crop Science*

Integration of Livestock Grazing and Row Crop Systems in Ohio and Southern Brazil

**Taylor, R.A.J.***Entomology*

Developing a Japanese Beetle Life System Model for Improved Assessment of Management and Quarantine Alternatives

**Velleman, Sandra G.***Animal Sciences*

Effect of Genetic Improvements in Growth Rate and Body Conformation on Breast Muscle Development

**Velleman, Sandra G.***Animal Sciences*

Effect of Selection for Growth Rate on Myosin Heavy Chain Temporal and Spatial Localization during Breast Muscle Development

**Velleman, Sandra G.***Animal Sciences*

Maternal Inheritance of Breast Muscle Morphology in Turkeys at Sixteen Weeks of Age

**Vodovotz, Yael***Food Science and Technology*

Functional Properties of Ohio Soybean Varieties in New Heart Healthy Bakery Products

**Weiss, William P.***Animal Sciences*

Vitamin C Status of Dairy Cows during an Intramammary Gland Bacterial Challenge

**Welty, Celeste***Entomology*

Management of Bacterial Wilt of Pumpkins

**Williams, Lance R.***School of Environment and Natural Resources*

Influence of Landscape Hierarchies on Food Web Structure in the Cuyahoga River System

**Yuan, Lijuan***Food Animal Health Research Program*

Impact of Gene 5 Sequence Rearrangements on Growth, Virulence, and Pathogenesis of Rotavirus

**Zhao, Lingying***Food, Agricultural and Biological Engineering*

Preliminary Assessment of Air Quality in Ohio Farms and Health Risk to Farmers and Their Neighbors

**2004****Balasubramaniam, V.M.***Food Science and Technology*

High Pressure Processing of Low-acid Foods

**Bonello, Pierluigi***Plant Pathology*

Mechanisms and Outcomes of Host-Mediated Systemic Interactions between Pathogens and Insects in Austrian Pine over a Nutrient Gradient

**Dami, Imed***Horticulture and Crop Science*

Improving Frost Protection of Ohio Grapes under Controlled Environment

**Dorrance, Anne E.***Plant Pathology*

Identifying Corn and Soybean Seed and Seedling Pathogens Limiting Stands in Ohio

**Ehsani, Mohammad R.***Food, Agricultural and Biological Engineering*

Cost-Effective Data Collection Techniques for Characterizing and Managing Variability in Quality and Yield of Grapes in Ohio

**Francis, David M.***Horticulture and Crop Science*

Increasing the Efficiency of Marker Assisted Selection through in Silico and Experimental Discovery of Single Nucleotide Polymorphisms

**Funk, Julie***Veterinary Preventive Medicine*

Quantifying the Reservoir of Resistance

**Gardner, David***Horticulture and Crop Science*

A New Test for Predicting Nitrogen Fertility Requirements in Turfgrass

**Goebel, Charles***School of Environment and Natural Resources*

Monitoring Plant Community and Large Wood Dynamics in Tributary Streams Following a Record Flood in the Cuyahoga Valley National Park

**Grewal, Parwinder S.***Entomology*

Virulence Mechanisms of *Moraxella osloensis* to the Slug *Derocerus reticulatum*

**Herms, Daniel A.**

*Entomology*

Impacts of the Growth Regulator Paclobutrazol and Fertilization on Pest Resistance and Stress Tolerance of Paper Birch and Austrian Pine

**Jasinski, James R.**

*Ohio State University Extension*

Reducing Insecticide Use in Cucurbits Through in-furrow Seed Specific Applications

**Lanno, Roman**

*Entomology*

Quantifying Ecological Risk from Agricultural Land Treated with Biosolids

**Loerch, Steven C.**

*Animal Sciences*

Liposome Protected Nutrients for Newly Received Feedlot Calves

**Mathers, Hannah M.**

*Horticulture and Crop Science*

Root Hardiness and Influence of DNA Herbicides in Overwintered Containers

**McSpadden Gardener, Brian B.**

*Plant Pathology*

Development of Molecular Markers Specific to Biocontrol Strains of *Bacillus subtilis*

**McSpadden Gardener, Brian B.**

*Plant Pathology*

Evaluation of Induced Resistance as a Mechanism for Controlling Anthracnose Fruit Rot in Fresh Market Tomatoes

**Miller, Sally A.**

*Plant Pathology*

Identification of Seed Treatments Effective in Eliminating Bacterial Pathogens

**Napier, Teddy L.**

*Human and Community Resource Development*

Public Involvement in Parks and Recreation Planning

**Pascall, Melvin**

*Food Science and Technology*

The Effect of High Pressure Processing on the Migration on Irganox 1076, an Antioxidant, from Polyethylene Films Used for Food Packaging

**Pasian, Claudio C.**

*Horticulture and Crop Science*

The Lower Cuyahoga Green Roof Viability Assessment Project

**Pate, Joy L.**

*Animal Sciences*

Identification of Novel Regulators of Bovine Ovarian Function

**Pratt, Richard C.**

*Horticulture and Crop Science*

Determination of Optimal Molecular Marker-Assisted Selection Procedures for Improvement of Disease Resistant and Quality Protein Maize Germplasm

**Sreevatsan, Srinand**

*Food Animal Health Research Program*

Comparative Pathogenomics of Epidemiologically and Genetically Diverse Strains of *Mycobacterium avium* subspecies *paratuberculosis*

**Sreevatsan, Srinand**

*Food Animal Health Research Program*

Assessment of the Use of Paraffin Baiting for Diagnostic of the Johne's Disease Pathogen, *Mycobacterium Avium* Subspecies *Paratuberculosis* (Map)

**Stinner, Deborah H.**

*Entomology*

Developing a Nutraceutical Market for High-Oil Hull-Less Oats in Ohio

**Stinner, Deborah H.**

*Entomology*

Building Capacity for High Quality Organic Spelt Production for Local and Regional Spelt Producers

**van der Knaap, Esther**

*Horticulture and Crop Science*

Instrumentation for High-Throughput Genotyping, Fingerprinting and Sequencing Projects

**Vodovotz, Yael**

*Food Science and Technology*

Effects of Food Matrix on Bioavailability of Soy Isoflavones

**Wang, Guo-Liang**

*Plant Pathology*

Identification and Mapping of Putative Suppressor Genes of Spl11, a Rice E3 Ubiquitin Ligase Involved in Plant Cell Death and Broad Spectrum Disease Resistance

**Zhao, Lingying***Food, Agricultural and Biological Engineering*

Characterization and Abatement of Air Emissions from Egg Laying Facilities

**Zhao, Lingying***Food, Agricultural and Biological Engineering*

Development of a Prototype Wet Scrubber for Reduction of Dust and Ammonia Emissions from Poultry Buildings

**2005****Barringer, Sheryl***Food Science and Technology*

Improving the Safety of Ready to Eat Egg Products

**Belury, Martha A.***Human Nutrition*

Role of Conjugated Linoleic Acid in Muscle Steatosis in Insulin Resistance

**Bennett, Mark A.***Horticulture and Crop Science*

Vegetable Transplant Production Strategies for Increased Field Establishment, Survival and Optimum Yields

**Bomser, Joshua A.***Human Nutrition*

Protective Effects of Antioxidants Against Cataractogenesis in Dogs

**Bouchard, Virginie L.***School of Environment and Natural Resources*

Collaborative Research: Aboveground-Belowground Interactions: Relating Plant and Microbial Community Composition and Diversity to Methane Cycling in Wetland Ecosystems

**Cardenas-Seijas, Horacio***Animal Sciences*

Effects of Androgens on Estrogen Receptor Turnover

**Cardina, John***Horticulture and Crop Science*

Microbial Communities Associated with Soils and Weed Seeds

**Christy, Ann D.***Food, Agricultural and Biological Engineering*

Bio-electricity from Agricultural Lignocellulose Wastes

**Delwich, Jeannine F.***Food Science and Technology*

Development of Highly Palatable Reduced Calorie Ice Cream and the Impact of Label Information on Consumer Acceptance

**Dick, Warren A.***School of Environment and Natural Resources*

U.S. Department of Agriculture (USDA) National Needs Fellowship

**Dick, Warren A.***School of Environment and Natural Resources*

Research and Demonstration of Beneficial Agricultural Uses of FCD Products in Ohio

**Doohan, Douglas***Horticulture and Crop Science*

Strawberry Cultivar Tolerance of New Weed Control Practices

**Ellis, Michael A.***Plant Pathology*Evaluation of Strobilurin Fungicides (Abound and Cabrio), Potassium Phosphite, and Ridomil Gold for Use in a Disease Forecasting System for Strawberry Leather Rot Caused by *Phytophthora cactorum***Failla, Mark L.***Human Nutrition*

Strawberries as a Functional Food: Chemoprevention of Bladder Cancer

**Francis, David M.***Horticulture and Crop Science*

Tomato as a Functional Food: Metabolic Engineering of Carotenoid Biosynthesis

**Goebel, Charles***School of Environment and Natural Resources*

Developing a Model to Prioritize Riparian Restoration Efforts for the Rural-Urban Interface of the Cuyahoga Valley National Park

**Grewal, Parwinder S.***Entomology*

Development of a New Biological Product for Slug Control

**Hansen, Robert C.***Food, Agricultural and Biological Engineering*

Development of a State-of-the-Art Computer-Controlled Nutrient Delivery System for Container-Grown Landscape Nursery Crop Research



**Hooker, Neal H.**

*Agricultural, Environmental and Development Economics*  
Coordination, Cooperation and Market Orientation in Organic Supply Chains: The Case of Soybeans

**Jones, Michelle L.**

*Horticulture and Crop Science*  
Phosphoproteomic Analysis of Pollinated Petunia Styles

**Jones, Michelle L.**

*Horticulture and Crop Science*  
Role of Metacaspases in Petunia Petal and Leaf Senescence

**Lee, Kichoon**

*Animal Sciences*  
Understanding the Function of a Target Gene in Fat Cell Development

**Lindbo, John A.**

*Plant Pathology*  
Identification and Analysis of Proteins Involved in RNA Silencing (RNAi) in Plants

**Mackey, David**

*Horticulture and Crop Science*  
A Proteomic Analysis of the Virulence Targets of the Type III Effectors AvrRpm1 and AvrB

**Mahan, Donald C.**

*Animal Sciences*  
Enhancing the Value of Distillers Dried Grains with Solubles as a Non-Ruminant Feedstuff

**Miller, Sally A.**

*Plant Pathology*  
Enhancing Seed Health and Vigor in Tomatoes

**Ozkan, Erdal**

*Food, Agricultural and Biological Engineering*  
Effective Application of Fungicides to Control Asian Soybean Rust in Ohio

**Pate, Joy L.**

*Animal Sciences*  
Investigations on the Membrane-Bound Progesterone Receptor Expressed by Cells of the Bovine Immune System

**Precheur, Robert J.**

*Horticulture and Crop Science*  
Integrating Powdery Mildew Tolerance and Fungicide Disease Control Programs to Maximize Economic Return for Pumpkin Production

**Rhodes, Landon H.**

*Plant Pathology*  
Potential for Airborne Spore Dispersal by the Pathogen Causing Microdochium Blight of Pumpkin

**Rodewald, Amanda D.**

*School of Environment and Natural Resources*  
After the Invasion: Developing a Mechanistic Understanding of Ecological and Human Responses to Exotic Species to Inform Restoration Decisions

**Rodewald, Paul G.**

*School of Environment and Natural Resources*  
Using Stable Isotope Analysis to Link Seasonal Events in Migratory Landbirds

**Rodriguez-Saona, Luis**

*Food Science and Technology*  
Rapid and High Throughput Detection of Pathogenic Bacteria in Food Samples by Using Immunomagnetic Separation and Fourier-Transform Infrared Spectroscopy

**Roe, Brian E.**

*Agricultural, Environmental and Development Economics*  
Economics and Neuroscience: Using Functional Magnetic Resonance Imaging and Experimental Economics to Understand Behavioral Response to Economic Risk

**Stoel, Leslie**

*Consumer and Textile Sciences*  
Rural Retailers: Profiling Internet Users and Non-Users

**Struve, Daniel K.**

*Horticulture and Crop Science*  
Increasing Water and Nutrient Use Efficiency for Container-Grown Nursery Crops

**Velleman, Sandra G.**

*Animal Sciences*  
Regulation of the Growth of Turkey Skeletal Muscle

**Wang, Guo-Liang**

*Plant Pathology*  
Transcriptome Characterization and Genome Annotation in Maize (*Zea mays* L.) to Elucidate Host-responses to Economic Pathogens

**Wu, Steven**

*Agricultural, Environmental and Development Economics*  
An Experimental Investigation of Contractual Arrangements and Incentive Systems

**Yu, Zhongtang***Animal Science*

Reduction of Tetracycline Resistance Present in Food-Animal Manures by Composting and Anaerobic Digestion

**Yuan, Lijuan***Food Animal Health Research Program*

Immunological Mechanism of Probiotic Lactic Acid Bacteria in Prevention and Treatment of Rotavirus Diarrhea in Neonatal Swine

**2006****Bennett, Mark A.***Horticulture and Crop Science*

Use of Absciscic Acid (ABA) and Polyethylene Glycol 8000 (PEG 8000) to Control Vegetable Transplant Height

**Bomser, Joshua A.***Human Nutrition*

Glycitein: A Soy Isoflavone with Potential Anticancer Activity

**Bonello, Pierluigi***Plant Pathology*

Development of a Molecular Toolbox to Explore the Mechanisms of Localized and Systemic Induced Resistance in Austrian Pine

**Christy, Ann D.***Food, Agricultural and Biological Engineering*

Direct Conversion of Agricultural Wastes to Electricity Using Rumen Microbes in Microbial Fuel Cells

**Dick, Warren A.***School of Environment and Natural Resources*

Nitrogen Cycling and Kinetics in Manure, Compost and Soil

**Dick, Warren A.***School of Environment and Natural Resources*

National Network of Research and Demonstration Sites for Agriculture and Other Land Application Uses of FGD Products

**Doohan, Douglas***Horticulture and Crop Science*

Enhancing Agricultural and Food Safety Through Risk Analysis

**Dorrance, Anne E.***Plant Pathology*

Characterizing Pythium Populations from Corn and Soybean Fields in Ohio

**Firkins, Jeffrey L.***Animal Sciences*

Profiling Rumen Microbial Communities to Increase Efficiency of Microbial Protein Synthesis and Prevent Milk Fat Depression

**Goebel, Charles***School of Environment and Natural Resources*

Association of Salamanders and Downed Wood in Riparian Forests of Headwater Streams in the Cuyahoga Valley National Park

**Hermes, Daniel A.***Entomology*

Developing Functional Genomics Tools for the Planthopper *Peregrinus maidis*

**Hertzler, Steve***Human Nutrition*

Determination of the Glycemic, Insulin, and Satiety Index of a Soy Bread in Healthy Individuals

**Kamoun, Sophien***Plant Pathology*

Functional Cloning of Avirulence Genes from *Phytophthora infestans*

**Lee, Chang W.***Food Animal Health Research Program*

Characterization of Two Avian Cell Lines (DF-1 and QT-6) for Use in Studies of Avian Influenza Virus

**Lobao, Linda M.***Human and Community Resource Development*

Farm Animal Welfare in Ohio: Assessing Public Concern and Implications for the Food Animal Industry

**Loerch, Steven C.***Animal Sciences*

Effects of Low Dietary Vitamin A on Animal Health and Quality and Nutritional Characteristics of Beef

**Lyvers Pepper, Pasha A.***Animal Sciences*

Assessment of Perinatal Docosaheptaenoic Acid and Arachidonic Acid in a Premature Piglet Model

**Miller, Sally A.***Plant Pathology*

The International Plant Diagnostic Network (IPDN): A Multinational Collaboration

**Prasad Vadrevu, Krishna**

*Entomology*

Mapping Ash Tree Distributions and Emerald Ash Borer Infestations by Remote Sensing

**Pratt, Richard C.**

*Horticulture and Crop Science*

The Nature of the Association of *Pantoea stewartii*, the Causative Agent of Stewart's Bacterial Wilt of Corn, with Its Flea Beetle Vector, *Chaetocnema pulicaria*

**Precheur, Robert J.**

*Horticulture and Crop Science*

Integrating Powdery Mildew Tolerance and Fungicide Disease Control Programs to Maximize Economic Return for Pumpkin Production

**Rhodes, Landon H.**

*Plant Pathology*

Field Evaluation of Microdochium-resistant Pumpkins

**Wang, Hua**

*Food Science and Technology*

Antibiotic Resistance Gene Transfer in Dairy Fermentation

**Yousef, Ahmed E.**

*Food Science and Technology*

Elimination of Processing-resistant Microorganisms in Food Using Combinations

**2007**

**Basta, Nicholas**

*School of Environment and Natural Resources*

Characterization of Feedstocks and Candidate Mulches for the Development of a New Mulch Product for The Scotts Company

**Belury, Martha A.**

*Human Nutrition*

Inhibition of Muscle Atrophy by Dietary Conjugated Linoleic Acid

**Bisaro, David**

*Molecular Genetics*

The Role of Adenosine Kinase in Metabolic Defense Signaling

**Ellis, Michael A.**

*Plant Pathology*

Evaluation of Dormant Applications of Phosphite Fungicides Combined with the Bark Penetrating Adjuvant Penra-Bark for Early Season Control of Apple Scab

**Failla, Mark L.**

*Human Nutrition*

Soy Saponins and Gut Health

**Fluharty, Francis L.**

*Animal Sciences*

Creation of a Grass-Based Beef Research, Processing, and Marketing Initiative for the High-Value, Health Conscious Consumer Market Segment

**Francis, David M.**

*Horticulture and Crop Science*

Genetic Resources for Grafted Vegetable Production

**Giusti, Monica**

*Food Science and Technology*

A High Field Nuclear Magnetic Resonance-Based Approach to Profile Biologically Active Plant Metabolites Using Black Raspberry-mediated Inhibition of GI Tract Cancer Cells as a Model System

**Goebel, Charles**

*School of Environment and Natural Resources*

Phytosanitation of Emerald Ash Borer Infected Firewood

**Graham, Madge**

*Plant Pathology*

Exploring the Mechanisms and Genes Involved in Chemically Induced Cell Death and Disease Resistance in Soybean

**Grewal, Parwinder S.**

*Entomology*

Developing a Novel Commercial Delivery System for Entomopathogenic Nematodes

**Keener, Harold M.**

*Food, Agricultural and Biological Engineering*

Optimization of Natural Fibers Processing Equipment for Plastics Reinforcement

**Kleinhenz, Matthew D.**

*Horticulture and Crop Science*

Domestication and Commercialization of *Paraxacum kok-paghyz* — A New Crop to Fuel Ohio's Agricultural and Rubber Industry

**LeJeune, Jeffrey T.**

*Food Animal Health Research Program*

Scientific Cooperative Exchange Program

**Lewandowski, Dennis***Plant Pathology*

Building the System to Efficiently Screen for Hosta Virus X Resistance

**Mackey, David***Horticulture and Crop Science*

Comparative Studies of Three Related Type III Effector Proteins Essential for Virulence of Plant Pathogenic Bacteria

**Martin, Jay F.***Food, Agricultural and Biological Engineering*

Urbanization and Lake Erie Tributary Water Quality: A Dynamic Spatial Model with Policy Scenarios

**Melgar-Quinonez, Hugo***Human Nutrition*

Food Insecurity and Obesity: A Paradox Emerges

**Mitsch, William J.***School of Environment and Natural Resources*

Olentangy River Wetland Research Park Teaching, Research, Outreach Initiative

**Ozkan, Erdal***Food, Agricultural and Biological Engineering*

Reducing Pesticide Consumption through Targeted Application in Orchards and Vineyards in Ohio

**Pasian, Claudio C.***Horticulture and Crop Science*

Potential Uses of Fiberfill™ Clusters Made of Polyethylene Terephthalate (PET) or a Cellulose Polymer in Horticulture: Growing Media Component, Rooting Substrate, and Other Alternative Uses

**Pope, William F.***Animal Sciences*

Evaluating Organic (Bio Plex®) Trace Minerals in the Diet of Reproducing Female Pigs on Ovulation Rate, Embryonic Survival, Uterine Crowding, and Mineral Composition of Conceptus Products

**Rajashekara, Gireesh***Food Animal Health Research Program*

Novel Imaging Methodologies to Study Campylobacter Pathogenesis in Livestock Production Research

**Reeder, Randall C.***Food, Agricultural and Biological Engineering*

Evaluating Impact of Bulk Handling Systems on Seed Grains

**Rhodes, Landon H.***Plant Pathology*

Field Evaluation of Microdochium-resistant Pumpkins, Year 2

**Roberts, Matthew C.***Agricultural, Environmental and Development Economics*

Electricity Generation from Manure in Ohio: An Analysis of Consumer Willingness to Pay, Producer Interest, and Regulatory Barriers to Marketing Biogas-Sourced Electricity

**Sam, Abdoul***Agricultural, Environmental and Development Economics*

An Empirical Study of the Effects of Pollution Prevention Practices on Innovation in Environmental Technologies

**Scharff, Robert***Consumer and Textile Sciences*

Time Preferences, Commitment Mechanisms and Obesity

**Sheldon, Ian M.***Agricultural, Environmental and Development Economics*

China's Agricultural Trade: Issues and Prospects

**Taylor, R.A.J.***Entomology*

Implications of Climate Change for Agricultural Pest Management

**Wang, Guo-Liang***Plant Pathology*

Development of a Quantitative Bimolecular Luciferase-based Complementation System for Protein-protein Interaction Assay in Plants

**Wang, Hua***Food Science and Technology*

Limiting Antibiotic Resistance Microflora in Dairy Fermentation

**Welty, Celeste***Entomology*

Cucumber Beetle Management by an Early-Season Trap-Out Tactic

**Zhao, Lingying***Food, Agricultural and Biological Engineering*An On-farm Tool for Management of Nitrogen Nutrient Loss and NH<sub>3</sub> Emission from Animal Manure



**2008**

**Balasubramaniam, V.M.**

*Food Science and Technology*

Development of Chemical Markers as Indicators of Process Non-uniformity During Pressure Assisted Thermal Processing of Low-acid Shelf Stable Foods

**Bonello, Pierluigi**

*Plant Pathology*

Testing the Systemic Induced Resistance Hypothesis: Implications for Plant Defense Theory

**Botheras, Naomi**

*Animal Sciences*

Behavioral Responses of Dairy Cows to Mastitis

**Canas, Luis**

*Entomology*

Development of a Novel Nematode Release System for Preventive Management of the Fungus Gnat *Bradysia difformis* in Ornamentals

**Canas, Luis**

*Entomology*

Using Biological Control to Manage Aphids (Homoptera: Aphididae) on Hydroponic Lettuce

**Dorrance, Anne E.**

*Plant Pathology*

Targeted Identification of the SNP Markers for Gene Cloning Using the Solexa Genome Analyzer

**Ezeji, Thaddeus**

*Animal Sciences*

Towards Better Lignocelluloses to Butanol Conversion

**Giusti, Monica**

*Food Science and Technology*

Rapid Determination of Concord Grape Content in Commercial Grape Juices

**Graham, Terrence L.**

*Plant Pathology*

A Chemogenomics Approach to Optimizing Isoflavone Defense Pathways in Soybean

**Grewal, Parwinder S.**

*Entomology*

Virulence Determinants of Entomopathogenic *Photobacterium* and *Xenorhabdus* Bacteria

**Hansen, Robert C.**

*Food, Agricultural and Biological Engineering*

Properties of Natural Fibers Used for Plastics Reinforcement

**Hoy, Casey W.**

*Entomology*

Acoustic Monitoring of Agroecosystem Rhythm, Function, and Change

**Jackwood, Daral J.**

*Food Animal Health Research Program*

Production of an Infectious Bursal Disease Virus Vaccine in Insect Larvae Using the Baculovirus Expression System

**Jasinski, James R.**

*Ohio State University Extension*

Powdery Mildew Fungicide Insensitivity Evaluations on Pumpkin Foliage

**Kleinhenz, Matthew D.**

*Horticulture and Crop Science*

Germplasm Enhancement and Variety Development in *Taraxacum kok-saghyz* (TKS): Rubber Yield and Quality in Four Populations Differing in Phenotype and Selection

**Lee, Chang W.**

*Food Animal Health Research Program*

Development of a Triplex Microsphere-based Assay for the Detection and Differentiation of H5 and H7 Hemagglutinin Subtypes of Influenza Virus

**Lee, Kichoon**

*Animal Sciences*

Study on the Pro-myogenic and Anti-adipogenic Functions of Delta Like protein 1 (DLK1) in Chicken

**LeJeune, Jeffrey T.**

*Food Animal Health Research Program*

Identification of Microbiological Factors that Suppress *E. coli* O157 in Livestock Bedding

**LeJeune, Jeffrey T.**

*Food Animal Health Research Program*

Molecular Epidemiology of *Clostridium difficile* in Ohio

**Li, Yebo**

*Food, Agricultural and Biological Engineering*

Development of a Consolidated Bioprocess for Converting Lignocellulosic Biomass to Biofuel and Biobased Products

**Li, Yebo**

*Food, Agricultural and Biological Engineering*

Development and Demonstration of a 4-in-1 Sustainable Energy System

**Mackey, David***Horticulture and Crop Science*

Defining Specificity Determinants within the Arabidopsis  
NB-LRR R-proteins RPM1 and RPS2

**Martin, Jay F.***Food, Agricultural and Biological Engineering*

Tracking Microbial Community Changes in Variable  
Temperature Anaerobic Digesters

**Michel, Andrew***Entomology*

Genome Scanning and the Genetics of Adaptation  
within the Apple Maggot Fly, *Rhagoletis Pomonella*

**Partridge, Mark***Agricultural, Environmental and Development Economics*

Appraising Economic Development and Land-Use Policies  
to Build Healthy Rural and Urban Communities

**Pratt, Richard C.***Horticulture and Crop Science*

Development of Genetic Variation for Anthocyanin and  
Carotenoid Pigment Content in Native American Maize

**Rhoades, Emily***Human and Community Resource Development*

What Does Agriculture Have to Do With It? Critical Thinking  
Skills of Agricultural Communication Trained Versus  
Journalism Trained Media

**Rhodes, Landon H.***Plant Pathology*

Field Evaluation of Microdochium-resistant Pumpkins, Year 3

**Rodriguez-Saona, Luis***Food Science and Technology*

Analysis of Swiss Cheese Bacterial Cultures to Streamline  
Control of Fermentation Processes

**Rodriguez-Saona, Luis***Food Science and Technology*

Food Applications of a Handheld Portable Infrared Sensor

**Selvaraj, Ramesh***Animal Sciences*

Characterization of Chicken T Regulatory Cells

**Sneller, Clay***Horticulture and Crop Science*

Converting Flour Mill Byproducts into Bioenergy

**Sporleder, Thomas***Agricultural, Environmental and Development Economics*

An Economic Assessment of the Emerging Renewable  
Polymer Cluster in Ohio — Current Size and Growth  
Potential, with Estimated Economic Impact on the  
State's Economy

**Stinner, Deborah H.***Entomology*

Development of an Integrated Management System  
for High Quality Organic Spelt to Meet New Marketing  
Opportunities in Ohio

**Stoel, Leslie***Consumer and Textile Sciences*

Profiling Chinese Consumers' Preferences for Soy-Based  
Dietary Supplements

**van der Knaap, Esther***Horticulture and Crop Science*

Towards the Cloning of the Tomato FS8.1 Gene using  
Differential Expression and Massively Parallel Signature  
Sequencing (MPSS) Technology

**Vodovotz, Yael***Food Science and Technology*

Determination of the Glycemic, Insulin, and Satiety Index  
of a Soy Pretzel in Healthy Individuals

**Vodovotz, Yael***Food Science and Technology*

The Use of Functional Confections for Promoting  
Oral Health

**Vodovotz, Yael***Food Science and Technology*

Celiac Disease and Gluten Intolerance Research and  
Development for a Gluten Replacement in Bakery  
Products, Phase I

**Yu, Zhongtang***Animal Sciences*

Development of a Temperature-Phased Anaerobic  
Digestion Process for Enhanced Conversion of Solids  
in Livestock Manure and Food Wastes to Methane

**Zhao, Lingying***Food, Agricultural and Biological Engineering*

The Development of Nano-scale Ceramic Oxide Electron  
Mediators for Enhanced Microbial Fuel Cell Power  
Generation

**2009**

**Canas, Luis**

*Entomology*

Greenhouse Ohio

**Cardina, John**

*Horticulture and Crop Science*

Genetic, Age, and Spatial Structure to Improve Invasive Plant Management Strategies

**Dabrowski, Konrad**

*School of Environment and Natural Resources*

Commercial Potential of Replacement of Plant (Gluten) Protein with Algae Protein for Growth Enhancement of Fish

**Disilvestro, Robert A.**

*Human Nutrition*

Soy Saponins and Garlic Extract for Cholesterol Lowering

**Doohan, Douglas**

*Horticulture and Crop Science*

New Tools for Weed Management in Brambles

**Gardiner, Mary**

*Entomology*

A Landscape-Scale Approach to Understanding Native Coccinellidae Decline

**Giusti, Monica**

*Food Science and Technology*

Quantification of Isoflavone Transfer from the Feed into Hen Tissues

**Gourapura, Renukaradhya**

*Food Animal Health Research Program*

Study of Mucosal Immune Response in the Respiratory Tract of Pigs Infected With Porcine Reproductive and Respiratory System Virus

**Grewal, Parwinder S.**

*Entomology*

Effect of Organic and Inorganic Fertilizers on Turfgrass Ecosystem Health

**Grewal, Parwinder S.**

*Entomology*

Identifying Stakeholder Needs for Establishing a Vibrant Urban Specialty Crop Enterprise

**Harrison, Earl**

*Human Nutrition*

Occurrence and Function of New Carotene Metabolites in Human Cells

**Jang, Jyan-Chyun**

*Horticulture and Crop Science*

Plant Peptide Hormone Technology in Enhancing Biomass and Fitness to Environmental Stresses

**Jasinski, James R.**

*Ohio State University Extension*

Validating Field Rate Fungicide Insensitivity to Powdery Mildew on Pumpkin and Melon

**Lejeune, Jeffrey T.**

*Food Animal Health Research Program*

Applied Research to Support of Scientific Validation of Good Agricultural Practices to Enhance Safety and Maintain Marketability of Ohio Produce

**Li, Jianrong**

*Food Science and Technology*

Development of Novel Multivalent Vaccines for Porcine Reproductive and Respiratory Syndrome Using Interferon-Inducing Attenuated Vesicular Stomatitis Virus as the Vector

**Li, Yebo**

*Food, Agricultural and Biological Engineering*

Development of Membrane System for Cost-Effective Treatment of Anaerobic Digester Effluent

**Li, Yebo**

*Food, Agricultural and Biological Engineering*

Development of Combined Liquid and Solid State Anaerobic Digestion Process for Methane Production from Sewage Sludge and Organic Waste

**McSpadden Gardener, Brian B.**

*Plant Pathology*

The Search for New Mechanisms: Linking Genes and Metabolites to Phenotype in Novel Biocontrol Bacteria

**Mercer, Kristin**

*Horticulture and Crop Science*

Adaptive Importance of Flowering Time for Agricultural Production Under Global Change

**Miller, Sally A.**

*Plant Pathology*

Efficacy of Injected Disinfectants in Killing Zoonotic Pathogens and Zoospores of Plant Pathogens in Irrigation Water

**Mitchell, Thomas**

*Plant Pathology*

Sequencing and Characterization of Small Conditionally Dispensable Chromosomes Responsible for Host Specificity in *Alternaria*

**Mittapalli, Omprakash***Entomology*

Functional Genomics of Emerald Ash Borer

**Qu, Feng***Plant Pathology*

A Virus-Induced Gene Silencing Vector for Model Plant Arabidopsis

**Rajashekara, Gireesh***Food Animal Health Research Program*

TAT Protein Export Pathway of Campylobacter jejuni: A Potential Anti-Campylobacter Target

**Saif, Linda J.***Food Animal Health Research Program*

Enhancing Rotavirus Vaccine Efficacy: Impact of Vitamin A as Adjuvant

**Stinner, Deborah H.***Entomology*

Cultivar Evaluation and Development of Hard Winter Wheat for Organic Production in Ohio to Meet New Marketing Opportunities for Ohio's Organic Farmers, Millers and Bakers

**Wang, Guo-Liang***Plant Pathology*

Towards Molecular Dissection of the AvrPiz-t and Piz-t Interaction in Rice

**Wang, Hanping***Centers at Piketon*

Establishing Ohio Soy-Aqua Research and Development Initiative

**2010****Barker, David***Horticulture and Crop Science*

Establishment of Miscanthus x giganteus and Arundo donax from rhizome

**Cardina, John***Horticulture and Crop Science*

Commercialization of Burdock (Arctium spp.) for Medicinal Uses

**Daniels, Kristy***Animal Sciences*

Phenotypic Modulation of Mammary Cells via Endocrine Mediators

**Dick, Warren A.***School of Environment and Natural Resources*

Enhancing Soybean Health and Seed Yield by FGD Gypsum Application to Intermittently Wet Soil

**Disilvestro, Robert A.***Human Nutrition*

A Pilot Study of Evening Primrose Oil and Weight Control Related Processes

**Doohan, Douglas***Horticulture and Crop Science*

Understanding the Nature of Parasitism in Dodder (Cuscuta spp.) from a Reproduction Aspect Flowering Initiation

**Failla, Mark L.***Human Nutrition*

Effects of Saliva and Oral Microbiota on the Metabolism of Anthocyanins

**Gardiner, Mary***Entomology*

Evaluating the Pesticide Contamination of Pollinators and Their Provisions Across an Urban-to-Rural Landscape Gradient

**Lee, Kenneth***Food Science and Technology*

Improvement of Fresh Ohio Produce within Ohio's Electron Beam Facility

**Lee, Kenneth***Food Science and Technology*

Evaluation of Antimicrobial Surface Coatings for the Ohio Food Industry

**Li, Yebo***Food, Agricultural and Biological Engineering*

Production of Algae for Biofuels with Effluent of Liquid Anaerobic Digestion

**Li, Yebo***Food, Agricultural and Biological Engineering*DOE: Reutilization of Industrial CO<sub>2</sub> for Algae Production Using a Phase Change Material**Mackey, David***Horticulture and Crop Science*

Analysis of Type III Secretion Over Time during Plant-bacteria Interactions

**Mathers, Hannah M.***Horticulture and Crop Science*

"Greening the Highways" — Sustainable Tree Plantings Using Ohio and Ontario Grown Tree Liners



**McHale, Leah**

*Horticulture and Crop Science*

Evaluation of Viral Expression Systems to Assay Plant Recognition of Putative Pathogen Effectors in Soybean

**McSpadden Gardener, Brian B.**

*Plant Pathology*

Genomic Analysis to Advance the Commercial Development of a Novel Microbial Biopesticide for Fusarium Head Blight of Wheat

**Miller, Sally A.**

*Plant Pathology*

Developing New Strategies for Management of Bacterial Canker in Tomatoes

**Mittapalli, Omprakash**

*Entomology*

Gene Discovery in Bed Bugs

**Taylor, Christopher**

*Plant Pathology*

Identifying Genes Involved in Regulating Adventitious Hairy Root-Formation

**Wang, Hua**

*Food Science and Technology*

Impact of Food Intake on the Rapid Emergence of Antibiotic Resistance in the Hosts

**Yu, Zhongtang**

*Animal Sciences*

Development of a Habitat-specific Microarray for the Analysis of Ruminal Microbiomes

**2011**

**Belury, Martha A.**

*Human Nutrition*

Reducing Visceral Adipose Tissue in Postmenopausal Women with Dietary Oils

**Bennett, Mark A.**

*Horticulture and Crop Science*

Rate and Volume of Abscissic Acid (S-ABA) to Control Vegetable Transplant Height in Tomatoes and Other Vegetable Crops

**Bomser, Joshua A.**

*Human Nutrition*

Anti-inflammatory Effects of Green and Black Tea in the Gastric Epithelium

**Bonello, Pierluigi**

*Plant Pathology*

Validation and Development of a Methyl Jasmonate Delivery System for Insecticide-Free Control of the Emerald Ash Borer

**Cole, Kimberly**

*Animal Sciences*

Development of Live Recombinant Salmonella Vaccine Vectors for Use Against Campylobacter in Commercial Poultry

**Cornish, Katrina**

*Horticulture and Crop Science*

Russian Dandelion (TKS) and Guayule Germplasm Improvement by Plastidic Transformation to Produce Isoprenoid Substrates for Rubber Biosynthesis

**Cornish, Katrina**

*Horticulture and Crop Science*

Novel Biopolymer Substrates for Medically Relevant Cell Differentiation and Tissue Growth

**Daniels, Kristy**

*Animal Sciences*

Jersey Calf Responses to High Protein, High Fat Liquid Feeds with Varied Fatty Acid Profiles

**Doohan, Douglas**

*Horticulture and Crop Science*

Herbicide Volatility, Spray Drift and the Vineyard: Recognition, Significance and Avoidance

**Fluharty, Francis L.**

*Animal Sciences*

Integration of Small Ruminants into Organic Cropping Systems: Impacts on Crop Production, Weed Control, Soil Profiles, and Animal Performance

**Francis, David M.**

*Horticulture and Crop Science*

Developing Resistance to Xanthomonas gardneri in Processing Tomatoes

**Gardiner, Mary**

*Entomology*

Use of a Generalized Random Tessellation Stratified Survey Design (GRTS) to Evaluate Beneficial Insect Diversity, Abundance, and Activity within the Cleveland Metroparks Reservations

**Goebel, Charles***School of Environment and Natural Resources*

Consequences of Hemlock Woolly Adelgid to Coupled Dynamics Across Riparian and Stream Ecosystems

**Goebel, Charles***School of Environment and Natural Resources*

Effects of Catastrophic Natural Disturbance on the Structure and Function of Forest Ecosystems

**Jasinski, James R.***Ohio State University Extension*

Determining the Distribution of a New Invasive Pest, the Brown Marmorated Stink Bug, in Key Vegetable and Small Fruit Crops

**Lee, Jiyoung***Food Science and Technology*

Multiple Genetic Marker Approach for Understanding the Impact of Land Use and Climate Change on Microbial Contamination in Water

**McSpadden Gardener, Brian B.***Plant Pathology*

Formulation and Field-based Evaluations of Algae-based Biofertilizers

**Mercer, Kristin***Horticulture and Crop Science*

Maize Adaptation Along an Altitudinal Gradient

**Michel, Andrew***Entomology*

Monitoring, Understanding and Managing Insect Threats to Ohio Soybean Production

**Miller, Sally A.***Plant Pathology*

A Systems Approach to Managing Microbial Threats to Greenhouse Tomatoes

**Miller, Sally A.***Plant Pathology*

Evaluation of Seed and Seedling Treatments to Control Angular Leaf Spot in Pumpkin

**Mitchell, Thomas***Plant Pathology*

Application of the EXZACT™ Precision Technology to Fungal Systems

**Pascall, Melvin***Food Science and Technology*

Shelf Life Extension of Selected Cookies by Modified Atmosphere Packaging and Antimicrobial Ingredient Formulation

**Pasian, Claudio C.***Horticulture and Crop Science*

Testing Organic Fertilizers to Grow Ornamental Bedding Plants in Soilless Mixes

**Rajashekara, Gireesh***Food Animal Health Research Program*Poly P Associated Enzymes of *Campylobacter jejuni*: Insights into Novel Pathogenesis Mechanisms and Anti-*Campylobacter* Targets**Regnier, Emilie E.***Horticulture and Crop Science*Identifying the Causal Factors Driving the Spread and Persistence of Giant Ragweed (*Ambrosia trifida*)**Vlasova, Anastasia***Food Animal Health Research Program*

Characterization of Emerging Human and Porcine Rotaviruses and Investigation of Homotypic and Heterotypic Immune Responses

**Vodovotz, Yael***Food Science and Technology*

Soy Isoflavone Absorption from Bakery Products Based on Lipid Source and Quantity

**Vodovotz, Yael***Food Science and Technology*

Optimization of PHBV Polymer Blended with Guayule Rubber for Potential Food Packaging Material

**Welty, Celeste***Entomology*

Developing Parasitoid Enhancement as a Component of Cole Crop Management





## Research Committee Members

**Larry Antosch**, Ohio Farm Bureau

**Jamie Cano**, Agricultural Communication, Education, and Leadership

**Imed Dami**, Horticulture and Crop Science

**Richard Dick**, School of Environment and Natural Resources

**Rob Fisher**, Ohio Department of Agriculture

**Dennis Hall**, Ohio BioProducts Innovation Center

**Earl Harrison**, Human Nutrition

**Chang-Won Lee**, Food Animal Health Research Program

**Peter Ling**, Food, Agricultural and Biological Engineering

**Brian McSpadden Gardener**, Chair, Plant Pathology

**Andrew Michel**, Entomology

**Gary Rawlings**, TECH Columbus

**Brian Roe**, Agricultural, Environmental and Development Economics

**Hua Wang**, Co-Chair, Food Science and Technology

**Macdonald Wick**, Animal Sciences

**F. William Ravlin**, Associate Director and Administrative Advisor,  
Ohio Agricultural Research and Development Center, Ex-Officio

**Steven A. Slack**, Director, Ohio Agricultural Research  
and Development Center, Ex-Officio

## Grant Development Support Unit

If you would like more information on the SEEDS program, please contact  
**Lori Kaser**, SEEDS Coordinator, Ohio Agricultural Research and Development Center

For more information, visit our website:

**[www.oardc.ohio-state.edu/seeds](http://www.oardc.ohio-state.edu/seeds)**





**Ohio Agricultural Research and Development Center**

1680 Madison Avenue • Wooster, OH 44691

115 Agricultural Administration Building • 2120 Fyffe Road • Columbus, OH 43210

[www.oardc.osu.edu/seeds](http://www.oardc.osu.edu/seeds)

